Electrical Review

With Which Is Consolidated WESTERN ELECTRICIAN and ELECTROCRAFT.

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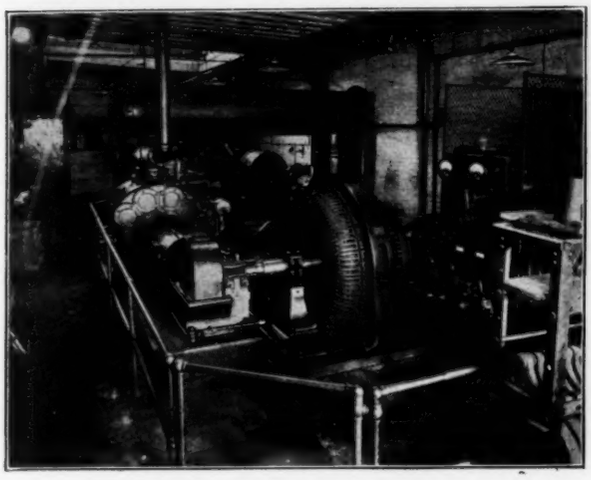


Synchronous Motor Driving Air Compressor.

Induction Motor Driving Blower.

Motor Drive in a Modern Foundry

Muskegon Plant Finds Economy in Purchased Power— An Aggregate of 1400 Horsepower in Motors Used —Energy Purchased from Consumers Power Company

MUSKEGON, Mich., is a growing industrial center, with practically all shops and factories operated by electric power, steam-power equipment being utilized mostly for heating purposes. Several of those plants are comparatively new industries, and others have so expanded in recent years as to require much new equipment installed in modern buildings. In all plants referred to electric power for motor drives and lighting is supplied by the Consumers Power Company, whose three 5000-kilovolt-ampere transformers receive current from its interconnected central stations at 72,000 volts, and which deliver current at the factory transformers at 7200 volts.

In noting the applications of electric power to shop and factory uses, special attention may be given to the large capacity plant of the Campbell, Wyant & Cannon Foundry Company, situated at Muskegon Heights, the factory suburb of Muskegon. Current is received at 7200 volts, with a frequency of 30 cycles, which for motor use is stepped down to 480 volts, three phase, through two 300-kilowatt, single-phase, open-delta transformers; and for lighting purposes this is reduced to 240/120 volts through two 50-kilowatt transformers. There is a rated motor load of 1400 horsepower in the entire plant; the motors are of the induction type, ranging in capacity from 150 horsepower down to ¼ horsepower. The one exception to the general induction type consists in a General Electric 300-horsepower synchronous motor, operated at 7200 volts, at a speed of 214 revolutions, and which is direct connected to an Ingersoll-Rand two-stage, air compressor, the air from which serves for sand blasts, for chipping and general purposes. Having this unit on the line with a heavy induction load enables them to operate with satisfactory power-factor. The energy requirements of the entire plant amount of 200,000 kilowatt-hours per month, the maximum constant demand being, approximately, 500 kilowatts.

The synchronous motor and the large two-stage air compressor which it drives are shown in an accompanying illustration, and a part view of an 80-volt, 40-ampere exciter, connected to the motor, is also given. In the background of the same illustration is shown a less distinct view of an Ingersoll-Rand two-stage compressor of smaller capacity, belt connected to a General Electric 150-horsepower induction motor. Another installation in this department is a steam-driven 10-kilowatt, 220-volt motor-generator set, producing direct current for operating a locomotive crane in the yards for scrap handling. All these installations are in the older shop and foundry department, the newer foundry, occupying the full length of a city block, being situated on the opposite side of the street.

The main foundry is equipped with six overhead electrically operated traveling cranes each of 60-foot span. Five of these are of the Shaw type, each of 3.5 tons capacity; in each case the bridge and hoist motors are of 11 horsepower, alternating current. The sixth crane is a Pawling & Harnischfeger type, 3.5 ton capacity, operated by motors of the same capacity as are the others.

Another feature of foundry equipment consists of

an overhead monorail line, having a run of 600 feet, with a two-ton electric hoist. This is the Shepard monorail, which is used for sand distributing through the day, and for handling rough castings during the night shift. There are two wall cranes in the foundry for manipulating the molds.

The four cupola furnaces are supplied with draft by Sturtevant, American and Buffalo forge blowers, the blower in each case being belt connected to a 50-horsepower motor by jack-shaft arrangement in which there is a flexible coupling between the motor and the pulley shaft. In one of the illustrations is a view of a Buffalo forge blower driven by a 50-horsepower General Electric motor, induction type. The cupolas, thus operated, have each a capacity of 16 tons of metal per hour.

Four motors of a combined capacity of 57.5 horsepower are required to operate four sand mixers, each mixer being driven by an individual motor by belt transmission. A sand-blast exhauster is driven by a 75-horsepower motor; and two large rattlers, each operating on ball bearings, self-oiling, are each driven by a 20-horsepower Fairbanks-Morse motor.

All energy is carried throughout the works in conduits, and is distributed by Cutter panel boxes to the several departments, all power cabinets being kept separate from the lighting circuits.

GOVERNMENT NEEDS MEN FOR SEARCHLIGHT REGIMENT NOW BEING ORGANIZED.

Opportunity for Young Men Possessing Electrical Experience or Fundamental Knowledge of Electricity and Mechanics for Special Service Abroad.

An excellent opportunity is being offered to young men possessing a knowledge of electricity and mechanics as well as experienced electricians, gas-engine operators and machinists to serve the Government effectively in its fight for democracy.

Searchlight Unit for Field Service.

The War Department is organizing a regiment of searchlight companies for special service abroad. These units will be highly specialized and used for battle illumination and anti-aircraft protection. The companies will be armed and equipped as regular military units and will form part of the regular army organization. They will be called upon for extremely active work in the war zone and pains are being taken in the selection of the personnel of the companies.

Who Can Qualify?

Men of proper experience who already have been drafted into service may in special cases be transferred. In order to obtain those of suitable qualifications, a special ruling will permit men within the draft age but not yet called, to be inducted direct into this regiment. The plan is to obtain bright, young, intelligent and ambitious men who possess a fundamental knowledge of electricity and mechanics as well as trained and experienced electricians, gas-engine operators and machinists. The enlisted personnel will embrace men experienced in one or more of the following occupations: Electrician, gas-engine operator, machinist, motor-truck driver, blacksmith, horseshoer, mechanic and general all-around utility men.

Men must first enlist as privates and will be paid $30 per month together with food, clothing, medical attention, etc. Non-commissioned grades will be available at rates of pay from $36 to $96 per month, and future promotion is open to those of ability.

Specialized service of this character offers unusual opportunities for those capable. The character of the work will be highly interesting and varied. The man who has the necessary training and ability cannot serve his country better than by joining such an organization.

Uses of Searchlight in War.

The war as it is now being fought offers great opportunities for the use of searchlights, both for defensive as well as offensive operations. Among the uses of projectors on the battlefield are the following:

To discover and keep in touch with the movements of the enemy during the night.

To seek out and illuminate hostile objectives, so as to fire upon them.

To blind the enemy.

To illuminate roads and possible hostile positions in the more distant foreground by periodically working the light.

To search the near foreground.

To support fire effect by illumination of hostile targets.

To disturb hostile works by alternate blinding and turning on the beam or by working the beam back and forth.

To blind opposing searchlights.

To support attacks in the foreground by throwing the beam in front of the advancing troops and screening their movements.

They help by revealing obstacles to their own artillery which is thus enabled to destroy them.

To blind the enemy and disturb his forward march and firing capacity and confusing him by making him think his plans are discovered.

To facilitate the landing of aviators at night.

For anti-aircraft work and night bombing defense.

The foregoing summarizes the general activities of this new regiment. Information may be obtained by writing direct to the Commanding Officer, 56th U. S. Engineers, Washington Barracks, D. C. The applicant must give the following information: (1) name; (2) address; (3) age; (4) married or single; (5) nationality; (6) will you enlist for the period of the war; (7) brief statement of education; (8) present occupation; (9) experience; (10) name and address of present or former employer; (11) whether or not the applicant has been drafted.

Cost Data on Drag-Line Operation for Coal Mine

Electrical Equipment at Mine of Locust Mountain Coal Company Shows Marked Saving—Control Equipment a Feature of Installation

By L. W. NICKEL

ONE OF the most interesting applications of electric control in a field where reliability is essential can be found in the electric control of a drag-line excavator. Such an excavator was recently installed by the Locust Mountain Coal Company, Shenandoah, Pa.

It is used for stripping coal beds, the stripping being done from 14 to 30 feet deep and the rock being drilled by steam drills and shot when encountered in the stripping process. In one position with this drag line it is possible to take a cut of 150 feet wide. Spoil banks are always dropped on surface which does not contain coal, that is, the excavator is always placed directly over the vein and followed by a steam or electric shovel. The drag-line method of stripping coal beds has found favor with mining engineers inasmuch as it is much cleaner than any other method as no rock or dirt can be spilled on coal when once cleaned, as is the case when it is necessary to run locomotive track for hauling rock and dirt which is taken off the surface.

Electric control of a drag line is preferred because no fireman is needed, no coal passer and no pipe man. Further, there is no water pipe to freeze up and on the coldest mornings no delay is necessary to start the stripping operation, it merely being necessary to close the main line switch and start operation. The only labor which is required for the operation of this machine is the drag-line operator, an oiler and a few men in the pit, whereas in stripping by means of steam shovels and hauling the dirt and rock locomotives the amount of labor required is increased six or seven times.

This drag-line excavator has a 24-foot diameter turntable, 150-horsepower hoist motor and 75-horsepower swing motor.

The turntable consists of 40 open-hearth steel rollers revolving between two 90-pound rail circles, 24 feet in diameter, one attached to the bottom of the revolving frame and one to the top of the base.

The main machinery is driven by a direct-geared 150-horsepower, 440-volt, slip-ring type motor, operating at a speed of 565 revolutions per minute and includes two drums, one of which winds the rope by means of which the bucket is dragged through the dirt and the other operates the rope by means of which the bucket is hoisted. There is also a small drum for the purpose of manipulating the rope by means of which the boom is lowered and raised.

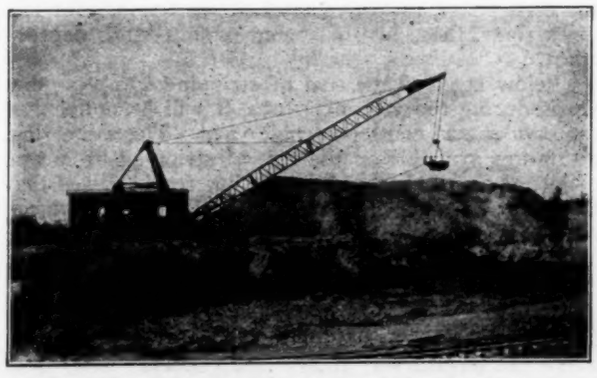
The swinging machinery is operated by a 75-horsepower, 440-volt, slip-ring type motor, driving a vertical swinging shaft by means of three gear reductions. A pinion on the vertical shaft engages the swinging rack on the base.

The master controllers, brake levers, etc., are all mounted at the front of the machine facing the boom at which point the operator can operate the machine without danger to the pitman.

The bucket has a capacity of 3½ cubic yards and is suspended by a three-part hoist, being dumped by locking or holding the third or single part of the hoisting line which is attached to the front end or arch of the bucket. After the brake is set, continued hoisting dumps the bucket. This brake or holding device consists of a drum, with a spring-actuated pawl and ratchet located near the front of the boom and operated from the operator's platform on the revolving frame.

The magnetic control panel furnished for this equipment by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., consists of double-pole magnetically operated switches equipped with series relays. The master drums which are mounted over the operator's head are of the bevel-gear type, equipped with punched-brass fingers having a forged-copper tip so designed as to prevent stubbing of the finger. The main motor controller is equipped with jamming relays so operated that the resistance is automatically cut into the rotor circuit when the motor is stalled. The maximum current taken by the motor under these conditions will not cause the circuit-breakers to open, thus the operator has control over the motor while it is stalled. This feature of stalling the motor and providing absolute protection makes it possible to obtain digging characteristics similar to that of a steam machine.

The controller for operating the swing motor is equipped with a plugging switch so that it is possible



Electric Drag-Line Excavator at Locust Mine, Shenandoah, Pa.

for the operator to throw the controller quickly to the maximum speed position and to reverse at full speed. The current inrush during this plugging period operates the series relay having control of the plugging switch, and in this way resistance is cut into the rotor circuit of the swing motor, so that the motor is fully protected during the plugging period. Because of the momentum of the boom on an equipment of this kind it is not necessary, under ordinary conditions, to

reverse at full speed ahead inasmuch as the operator very often throws the controller to central position at approximately 20 degrees ahead of the dumping pile,

Control Panels for Drag-Line Excavator at Locust Mine.

the momentum carrying the boom to this point, at which time the motor is plugged.

The grid resistance for the motors is mounted at the rear of the control boards in open frames thoroughly protected and ventilated.

The power for this installation is taken from the Harwood Electric Company, Hazelton, Pa., which is 22 miles distant, being transmitted at 25,000 volts to Shenandoah, at which point it is dropped down to 4000 volts and is again stepped down to 440 volts by the Locust Mountain Coal Company at its strippings, so that when brought to the drag line system, is three phase, 440 volts, 60 cycle. The transformers are mounted on a wagon.

The current is carried to the machine by means of a collector-ring equipment consisting of three copper rings mounted concentric with the center casting of machine, which revolve with the same. Heavy brass brushes are anchored on the machine to which the cable is attached, there being two brushes for each phase, making a total of six brushes for the three rings, these brushes being mounted 180 degrees apart.

Below is given the cost of stripping 256,710 cubic yards during the year of 1915. It will be noted that the cost is 4.23 cents per cubic yard. The writer has no figures available on the cost of stripping by means of locomotive and steam shovels but feels assured that this figure will be far in excess of the method described above.

Classification.	Labor—Amount.	Labor—Per Yard.	Material—Amount.	Material—Per Yard.	Total Cost Per Yard.
Shovel crew	$1,463.50	$0.0057	$ 82.26	$0.0003	$0.0060
Pitmen	1,697.80	.0066	5.16	.....	.0066
Blasters	107.02	.0004	1,804.22	.0070	.0074
Repair and maintenance	317.08	.0012	1,274.89	.0050	.0062
Electric repairs and maintenance	318.64	.0012	16.24	.0001	.0013
Transmission line	74.56	.0003	7.60	.....	.0003
Power	.....	.....	2,038.26	.0079	.0079
Foreman, etc.	339.16	.0013	2.25	.....	.0013
Clerk	40.50	.0002	.....	.....	.0002
Hauling	36.73	.0001	.....	.....	.0001
Miscellaneous	1,664.13	.0065	13.00	.0001	.0066
Total	$6,059.12	$0.0236	$5,243.88	$0.0204	$0.0440
Credit account timber, cutting brush, charged into colliery warehouse.	$ 427.25	$0.0017	.....	.....	$0.0017
Grand total	$5,631.87	$0.0219	$5,243.88	$0.0204	$0 0423

Below are some figures covering the cost of stripping 56,565 cubic yards during the month of October, 1915. It will be noted that this cost is reduced to 4.19 cents per cubic yard, there being quite some saving due to the absence of a blasting charge.

Classification.	Labor—Amount.	Labor—Per Yard.	Material—Amount.	Material—Per Yard.	Total Cost Per Yard.
Shovel crew	$ 391.97	$0.0069	$ 23.25	$0.0004	$0.0073
Pitmen	439.42	.0078	.....	.....	.0078
Blasting	.....	.....	.....	.....	.....
Repairs and maintenance	69.84	.0013	433.50	.0077	.0090
Electric repairs and maintenance	100.01	.0018	50.34	.0009	.0027
Transmission lines	40.77	.0007	.79	.....	.0007
Power	.....	.....	369.67	.0065	.0065
Foreman, etc.	111.86	.0019	.....	.....	.0019
Clerk	45.17	.0008	.....	.....	.0008
Hauling	79.25	.0014	.....	.....	.0014
Miscellaneous	157.61	.0028	53.34	.0010	.0038
	$1,435.90	$0.0254	$ 930.89	$0.0165	$0.0419

The control of this drag-line excavator illustrates the tendency, on the part of mining operators, to adopt electric-driven machinery and thereby profit by the advantages which it offers. The electric motor-driven shovel is also finding its way into the mining field, there being one used on the same stripping operation with the drag line described in this article. Very often this equipment is operated day and night, stripping the dirt and rock from the coal veins and clearing the way for shovels and locomotives to remove our finest anthracite coal to the breakers.

Large Motor-Driven Cotton Bale Press.

The Cotton Cellulose Company, England, has recently installed a 250-ton motor-operated cotton baling press. The machine is being used to compress and bale bleached cotton under maximum compression of 250 tons over a travel in excess of 13 feet. It is driven by two 25-horsepower series motors fitted with oil-immersed ball bearings. The motors are controlled by a controller of the street-car type that enables a very wide range of speeds and either parallel or series connection of the motors. The motors are operated in parallel for the larger portion of the compression, but toward the end of travel the controller is thrown to the series connection, thereby enabling reduced energy consumption. Series motor operation is used for lifting the table after compression, thus permitting quick lift. The two motors are connected to intermediary shafts, each of which is geared to one of the main drums of the press; and the two motors have their shaft pinions meshed together, to assure at all times uniform torque and speed of the individual drums.

The press is equipped with two packing boxes for loose cotton. Each box holds 5 hundredweight (English) or 650 pounds of loose cotton. A column of the loose materials measures 14 feet 6 inches in height with a base measuring 4 feet 3 inches by 2 feet 4 inches. When compressed this same material measures only 20 inches in height, without change in the base. The time required to compress a bale of the above weight and dimensions is 20 seconds and the energy is about ½ kilowatt-hour per bale, or more exactly 92 kilowatt-hours per 182 bales. The press was furnished by Hindle & Sons, Manchester, England.

The above motor-operated machine serves to emphasise the superb flexibility of electrical control. The rate of work is high, with accompanying economies of time, space and labor. The energy consumption is exceedingly low also. But perhaps the most remarkable thing is that by means of a controller operated with ease by a woman, such a machine may be controlled without any relation whatever between effort of machine and controller.

Simple Method of Testing Current Transformers

Outline of Tests by Which Laboratory Equipment May be Dispensed with and Large Numbers of Transformers Tested Quickly with Moderate Accuracy

A NUMBER of precise laboratory methods have been evolved for determining the ratio and phase angle of current transformers. However, these methods require special apparatus such as carefully calibrated non-inductive shunts and very sensitive alternating current detectors and thus are not ordinarily suited for central-station or shop conditions.

In Scientific Paper No. 309, Francis B. Silsbee, Bureau of Standards, describes a method of testing current transformers by comparing the constants of a standard transformer with one whose characteristics it is desired to determine, provided, of course, the standard transformer has the same nominal ratio as the transformer on test. The new method is somewhat analagous to the method developed by Brooks, and will be found more rapid than those of Agnew and Knopp. Amongst the advantages of the method evolved by Silsbee as in the other comparison methods is that the detector may be much less sensitive than in the absolute methods and thus the more rugged types of instruments such as the commercial wattmeter may be used. Multiple-range transformers are particularly useful as standards, since they show practically proportional ratios and identical phase angles on the various primary connections. Two or three such transformers, the ratio and phase angle of which have been accurately determined, suffice for testing a considerable range of transformers.

General Principles.

The principle of the method is illustrated by Fig. 1. S and X are the standard and the unknown transformer, respectively. The primary windings are connected in series and supplied with current from a suitable source. The secondary windings are also connected in series, with such polarity that both tend to send current in the same direction, and any desired impedance loads such as z_s and z_x complete the circuit. A suitable detector D is then connected so as to bridge across between the transformers.

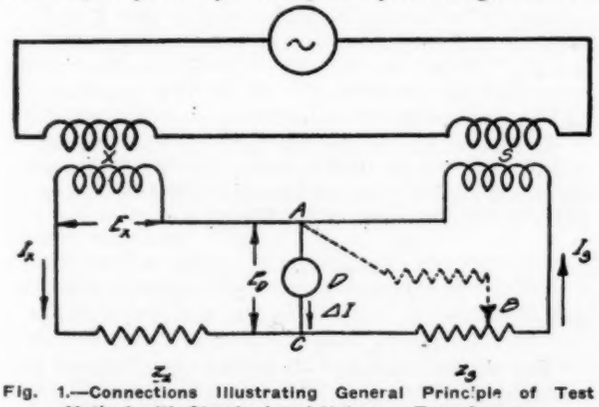


Fig. 1.—Connections Illustrating General Principle of Test Method with Standard and Unknown Transformer.

It is evident that the current ΔI through the detector (which we shall assume for the present to have a negligible impedance) is necessarily equal to the vector difference of the secondary currents I_s and I_x of the transformers. Consequently, if the magnitude and phase of ΔI are measured, the difference in performance of the two transformers can be computed. This measurement of ΔI may be made either directly by using as a detector one winding of a separately excited wattmeter, as is described below as the "Deflection method," or the measurement may be made indirectly by using an additional compensating circuit between A and B, as indicated by the dotted lines. By proper arrangement of the impedances all of ΔI may be made to flow in this compensating circuit, and the current in the detector reduced to zero. This is described below as the "Null method." There are, of course, a great many other possible arrangements for measuring ΔI, but the two here described in detail will be found the most convenient.

As the performance of a current transformer depends to a considerable extent upon the impedance of the apparatus and wiring connected in the secondary circuit, it is important to determine what impedance is introduced into the circuit of each transformer by the arrangement of circuits shown in Fig. 1. Now transformer X is carrying a current I_x at a terminal voltage E_x, and the equivalent impedance load is

$$Z_x = \frac{E_x}{I_x} = \frac{I_x z_x - E_d}{I_x} = z_x - \frac{E_d}{I_x} \quad \text{(vectorially)}$$

In the deflection method E_d (the voltage between the terminals of the detector) is

$$E_d = \Delta I z_d$$

And hence

$$Z_x = z_x - z_d \frac{\Delta I}{I_x} \quad \text{(vectorially)}$$

and similarly

$$Z_s = z_s + z_d \frac{\Delta I}{I_s} \quad \text{(vectorially)}$$

It is therefore evident that when the secondary currents are nearly equal, so that $\Delta I / I_s$ is very small, a detector of considerable impedance and therefore of high-current sensitivity may be used. On the other hand, when $\Delta I / I_s$ is large, then the use of a detector of high impedance may shift the load from the transformer of higher ratio to that having the lower and thus make the difference in ratio appreciably less than the correct value.

In the null method, on the other hand, E_d is zero when a balance is reached, so that

$$Z_x = z_x$$

and the performance of each transformer is the same as if the other transformer were replaced by a short-circuiting link across A C. Although very evident theoretically, this fact was also tested experimentally, and the behavior of the transformer was found to be the same as when the detector was replaced by a wire of negligible resistance.

The principal limitation on the sensitivity attainable in any method of testing current transformers is that the measuring circuit must not affect the performance of the transformer. This means that the measuring apparatus must not increase the equivalent connected secondary load by more than a certain resistance which we may denote by r.

The gain in sensitivity of a comparison method, such as is described in this paper over an absolute method, is seen by comparing the power available for operating the detector in the two cases. In the usual absolute method the secondary current I is passed through a noninductive resistance which is preferably equal to r. The voltage drop Ir is balanced by the drop due to the primary current flowing through a proportionately smaller resistance. With such an arrangement the impedance of the circuit external to the detector is approximately r, and for the maximum sensitivity the detector itself should also have this same impedance. If under these conditions the secondary current should differ by a small amount δI from that required for an exact balance, then the unbalanced voltage acting in the detector circuit will be only δIr. Since the resistance of the complete circuit is $2r$, the current flowing in the detector will be $\delta I/2$, and the voltage across the detector will be $\delta Ir/2$. Consequently the power available is $\left(\frac{\delta I}{4}\right)^2 r$.

On the other hand, in the case of the deflection method outlined in this paper, the total difference ΔI between the two secondary currents flows through the detector and produces a voltage at its terminals equal

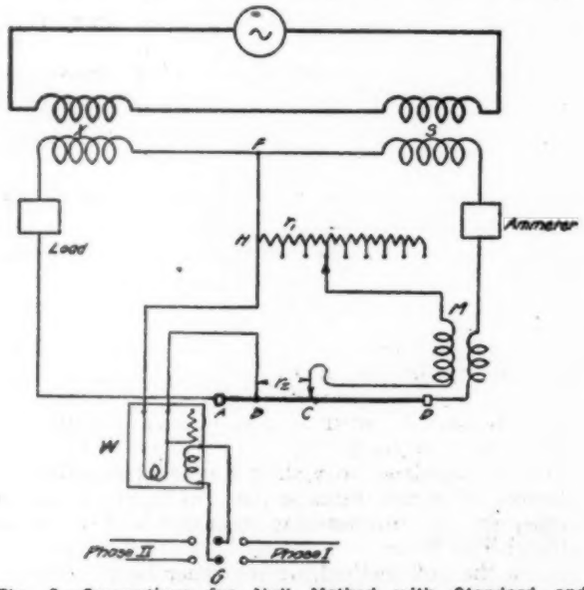


Fig. 2.—Connections for Null Method with Standard and Unknown Transformers.

to $\Delta I z_d$. Here z_d is the impedance of the detector, and is limited by the fact that this voltage $\Delta I z_d$ must not exceed the permissible value Ir for the largest value of ΔI. Consequently, we have $z_d \leqq I/\Delta I\, r$ and if we use a detector having this impedance, the volt amperes available for a difference δI in the currents is $\delta I^2 \left(\frac{I}{\Delta I}\right) r$.

Since the two transformers will usually differ by only a few per cent the factor $I/\Delta I$ is fairly large and the detector required may be 50 or 100 times less sensitive than in the precise laboratory methods. It is this relation which brings the method within the range of sensitivity obtainable with commercial pivoted instruments.

Null Method.

The connections of probably the most satisfactory form of null method based on the general arrangement outlined above are given in Fig. 2. $ABCD$ is a slide wire of about 0.2 ohm total resistance. M is a mutual inductance of about 600 microhenrys, the primary of which can carry 5 amperes without excessive heating. r_1 is a resistance of about 30 ohms, preferably capable of being set at several other values down to 2 ohms. As the value of r_1 appears in the denominator in the equations below it is convenient to have the total resistance between F and C, including the resistance of the secondary winding of M, an exact integer for each setting of r_1. M, r_1 and r_2 need be calibrated only to the per cent accuracy which is desired in the *difference* of the ratios; that is, to about 1 per cent.

The detector shown in the figure is a separately excited electro-dynamometer instrument. A commercial wattmeter of low-current range may be adapted for this work by bringing out taps directly from the moving coil without using any of the series resistance. The moving coil is connected as shown and the current coil excited by its full rated current in either of two phases, which preferably are in quadrature, through the double-throw switch G. Any other form of alternating-current detector sensitive to 0.00005 ampere might be used.

As a precaution a 10-ampere ammeter should be connected in parallel with the detector, so that the transformers will not be damaged if they have inadvertently been connected in opposition instead of aiding. If on closing the circuit this ammeter shows no appreciable current the polarity of the transformers is correct, and the ammeter should be disconnected.

The procedure is to adjust the position of the slider C and the value of the mutual inductance M until no deflection is obtained on closing G in either direction. When a balance is thus obtained all of the differential current ΔI is flowing through r_1, and also the difference of potential between points B and F is zero. Consequently, the voltage drops between C and F and between C and B must be equal and in phase with one another. From this relation the differences in the ratios and the phase angles of the two transformers may be computed.

If R_s and R_x are the ratios of the transformers S and X, respectively, and a_s and a_x are the corresponding phase angles, then we have for the case where the slider C is to the right of B (Fig. 2)

$$\frac{R_x}{R_s} = 1 + a - \frac{b^2}{2} - bc$$

and

$$\tan (a_x - a_s) = b + ac.$$

For the case where C is on the same side of B as transformer X, then

$$\frac{R_x}{R_s} = 1 - a + a^2 - \frac{b^2}{2} - bc$$

$$\tan (a_x - a_s) = b - ac - ab$$

where

$$a = \frac{r_2}{r_1}, \qquad b = \frac{\omega M}{r_1}, \qquad c = \frac{\omega L_1}{r_1}$$

and $\omega = 2\pi \times$ frequency.

r_1 = the total resistance between C and H through r_1 and M (Fig. 2), in ohms.

r_2 = the resistance of the slide wire between B and C, in ohms.

L_1 = the self-inductance of the secondary coil of the mutual inductance M, in henrys.

M = the value of the mutual inductance, in henrys. (This is to be taken as positive if a_x is greater than a_s as shown by the test described below.)

The second-order terms are usually very small and to an accuracy of a tenth per cent we have in either case

$$R_x = R_s (1 \pm a)$$
$$a_x = a_s + 3438\, b$$

if the angles are expressed in minutes.

If the balance is obtained with the slider between B and D (Fig. 2), then (provided the second-order terms are less than a), the standard transformer is supplying the greater secondary current and consequently has the smaller ratio. The question which secondary current leads the primary current by the greater angle can best be determined once for all by adding some resistance to the load on transformer X. This will always make I_x lead more than before and if the value of M required for a balance is increased then I_x was leading originally and M and b are to be taken as positive with this connection of the mutual inductance.

In the case when the slider C is to the right of B (Fig. 2) and the part AB of the slide wire is omitted, then the measuring circuits introduce no impedance whatever into the equivalent secondary circuit of transformer X. It is therefore possible by this arrangement to test a current transformer under the condition of zero external load. The load on transformer S or, in case C is to the left of B, on both transformers, is practically the same as the impedance of the slide wire and the primary winding of M. The slight change in this, due to the fact that r_1 in effect shunts r_2, is of the order ar_2 and its effect on the performance of either transformer is entirely negligible.

It is evident that if S always had a smaller ratio than X the slider would always be on the standard side of B and the part AB of the slide wire would be unnecessary, a very desirable arrangement since it does away with the necessity of allowing for the resistance of AB in making the total impedance load on transformer X equal to the desired value. The ratio of the standard transformer could be reduced by omitting a few turns from the secondary winding in the process of manufacture. In completed transformers of the hole type this can still be done by passing a few secondary turns through the hole in a direction to oppose the main secondary winding.

Since at the point of balance no current flows through the moving coil of the detector the self-inductance of this coil has no effect on the results. The mutual inductance between the two coils of the wattmeter, however, does produce an electromotive force between the points B and F even with no current flows and therefore affects the setting. This source of error can easily be eliminated by shifting the position of the control springs so that the normal zero of the instrument corresponds to the position of zero mutual inductance.

If the current in Phase I of the exciting circuit is in phase with the current in the transformers and Phase II is 90 degrees from this, then the slider C may be adjusted with G close to the right, and M with G to the left, and the two settings will be independent of each other. It is not at all necessary, however, that these phase relations be exact and Phase II may be 60 degrees from Phase I, as in a 3-phase system. If a polyphase supply is not available, current for Phase I may be drawn through a lamp bank and Phase II from the same supply through a reactance coil or transformer winding. With this arrangement it is well not to work the iron of the core much above its normal rating or the harmonics in the exciting current will become excessive.

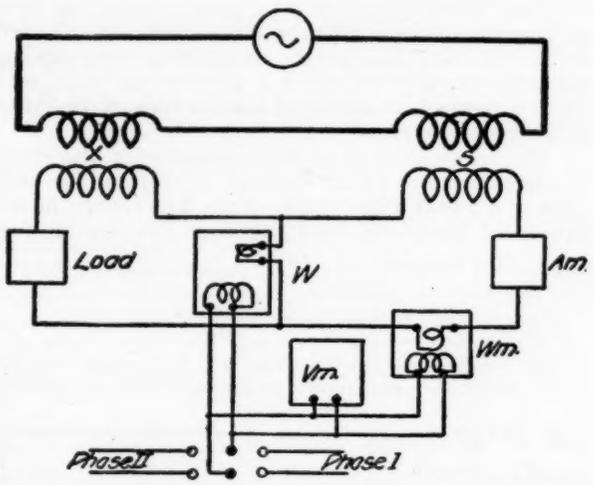


Fig. 3.—Connections for Deflection Method Using Polyphase Supply Instead of Variable Mutual Inductance and Slide Wire.

Deflection Method.

In cases where a variable mutual inductance and slide wire are not available, but a polyphase supply is at hand, the deflection method (see Fig. 3) may be used. The detector W in this method must be of the dynamometer type, and arranged so that one coil may be supplied from two circuits, one giving a current in phase with the current in the transformers and the other giving a current having a known phase relation, preferably quadrature with the former. If D_1 and D_q are the deflections in divisions, observed with the excitation in phase, and in quadrature, respectively, we have

$$\frac{R_x}{R_s} = 1 + \frac{K D_1}{I_s}$$

$$\tan (a_x - a_s) = \frac{K D_q}{I_s}, \text{ approximately}$$

where K is the constant of the instrument in amperes per division. If the wattmeter is excited by passing a current I_o through its current coil,

$$K = \frac{k}{I_o R_v}$$

where k is the constant in watts per division for a given range and R_v is the resistance of the voltage circuit of the same range. If the wattmeter is excited by applying a voltage E_o to the voltage circuit, then

$$K = \frac{k}{E_o}$$

In case the second phase available as a source of excitation is not in quadrature with the first, but gives exciting current which lags behind the current in the transformers by the angle θ and produces a corresponding deflection D_θ, then we have

$$\frac{R_x}{R_s} = 1 + \frac{K D_1}{I_s}$$

$$\tan (a_x - a_s) = \frac{K}{I_s}\left(\frac{D_0 - D_1 \cos\theta}{\sin\theta}\right)$$

Which secondary current is the greater and which leads the primary current by a greater angle can best be answered by changing the load on one transformer and noting the effect on the deflections, remembering that an increase in secondary resistance makes the secondary current smaller and also makes it lead the primary current more.

The principal limitation of this method is, the effect of the impedance of the detector in shifting the load from one transformer to the other. The change in the equivalent impedance load on either transformer due to this is given by

$$\Delta Z = \frac{z_d \Delta I}{I_s} = \frac{z_d K \sqrt{D_1^2 + D_0^2}}{I_s}$$

Since this varies with the deflection it is impracticable to allow for this impedance in arranging the secondary

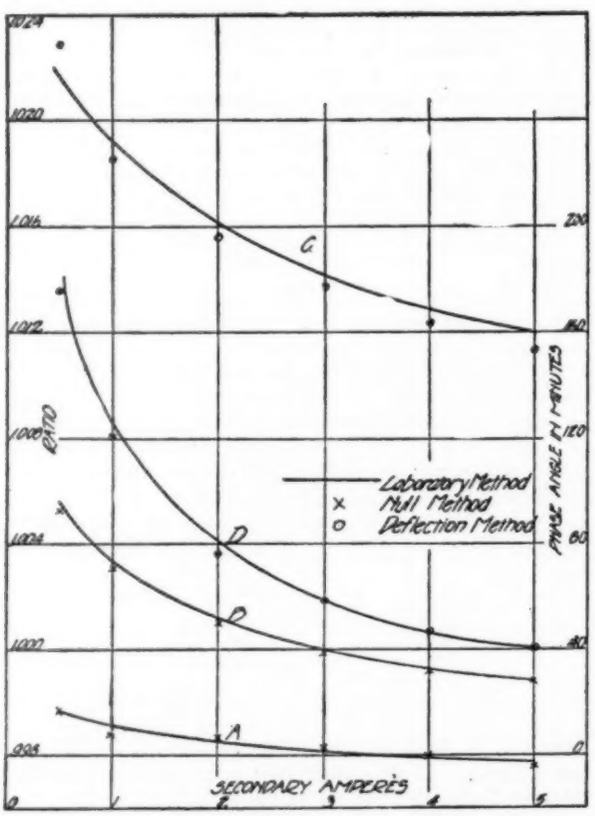


Fig. 4.—Curve Showing Experimental Results Obtained with Null and Deflection Methods and Precise Laboratory Method.

loads on the transformers and it is necessary to reduce ΔZ not to a comparatively small and definite value, as in the null method, but to a value which can be entirely neglected. If the moving coil of a commercial wattmeter is used as a detector, it must therefore be shunted by a rather low resistance and the sensitivity correspondingly reduced. The current circuit of a 1-ampere wattmeter has about the desired impedance and will be found satisfactory as a detector for this work. The use of the voltage circuit for the excitation is also convenient, since it avoids the necessity of a separate resistance.

The mutual inductance between the coils also introduces an equivalent load on the transformers, but if over the part of the scale used the coil is reasonably near the position of zero mutual inductance, this error will be less than that due to the impedance.

As a specific example of the various factors entering into the choice of a detector, let us consider the commercial wattmeter used in the experiments described below, which has the following constants:

Nominal current	2. amperes
Maximum current	3. amperes
Nominal voltage	75. volts
Maximum voltage	110. volts
Resistance of fixed coil	0.27 ohm
Resistance of moving coil	42. ohms
Resistance of voltage circuit	1,178. ohms
Watts per division	0.5

When this instrument is used with excitation on the voltage circuit we have

$$K = \frac{0.5}{110} = 4.5 \times 10^{-3} \text{ amperes per division,}$$

$z_d = 0.27$ ohm, approximately.

When used with excitation on the current circuit the moving coil must be shunted to give a resistance of about 1 ohm so that

$$K = \frac{0.5}{3 \times 1178} \times \frac{42}{1} = 6.0 \times 10^{-3}$$

amperes per division,

$z_d = 1$ ohm, approximately.

If the two transformers differ by 1 per cent in current, then at the 5-ampere point we have in the first case the deflection

$$D = 8.3 \text{ divisions}$$

and

$$\Delta Z = 0.003 \text{ ohm,}$$

and in the second case

$$D = 11. \text{ divisions}$$

and

$$\Delta Z = 0.01 \text{ ohm.}$$

A further error arises if the exciting voltages are not in the correct phase. The magnitude of this effect varies greatly with the difference in constants of the two transformers. If this difference is 1 per cent in ratio and 30 minutes in phase angle, a shift in phase of 7 degrees in the exciting voltage will produce an error of about 0.1 per cent in ratio and 3 minutes in angle. An auxiliary 5-ampere wattmeter connected as shown at *Wm* in Fig. 3 is a convenient means of determining these phase relations.

Experimental Results.

Both of the methods described above have been tried experimentally and the results are plotted on a large scale in Fig. 4. Curves *A* and *B* give the ratio factor and phase angle, respectively, of a 25-ampere, 40 volt-ampere portable current transformer at 60 cycles. The curve is drawn through values obtained by a precise laboratory method. The crosses are points observed by the null method using as a standard a similar transformer carrying considerably less load. Curves *C* and *D* give the ratio factor and phase angle of another transformer which was tested by the deflection method.

Turning Down Commutators.

When turning down a large commutator it is better to revolve the commutator away from the cutting tool instead of toward it. If the commutator stops rotating or should the tool slip, there is then no chance of the tool digging into the copper bars.

Effects of War Conditions on Cost and Quality of Electric Service

Analysis of Conditions in Electric Light and Power Service and Some of Their Remedies—From a Paper Presented Before the American Institute of Electrical Engineers

By L. S. GOODMAN and W. B. JACKSON

THE EFFECTS of war conditions in the public utility field are demanding at the present time the most careful consideration of both the operating and the regulatory bodies throughout the country. We have had a preliminary course of training, as it were, both in the experience of our foreign contemporaries and in our own experience prior to and to extend far beyond the termination of the war. But there is a wide difference between the effect on the electric utility field of this country, with the nation in the status of a neutral with its industries independently meeting the demands of the domestic and foreign markets, compared with the conditions produced by the United States standing as a growing war power, collecting, directing and conserving its vast resources for the prosecution of the conflict.

War conditions are extraordinarily affecting every department of production and distribution of electrical power, and the results not only have to do with the present and immediate future, but the effects are likely to extend far beyond the termination of the war. How far these effects will reach into the future will depend not only upon the length of the war, but to a large extent upon their treatment during its progress, and how resolutely the situation is now faced by engineers, bankers and government officials.

Principal Effects of the War on Electric Service.

The principal directions in which the effects of war conditions on electric service appear are:

1.—In relation to operating:

(a) In increased salaries and wages paid for operating.

(b) In difficulty of retaining trained operatives, and conversely the need to operate with partially trained forces.

(c) In increased cost and difficulty of obtaining fuel and in reduction of its uniformity and quality.

(d) In increased cost of other supplies and materials for operation and maintenance.

(e) In the need for protecting the properties against enemy agents.

(f) In increased taxes.

(g) In possible decrease of consumption of electric power by ordinary customers.

(h) In possible changes of load-factor.

2.—In relation to extensions of plant:

(a) In the necessity in many cases for quickly caring for large accessions of permanent and temporary business.

(b) In increased cost over normal for plant required to care for additional business.

(c) In high cost for money and difficulty of obtaining it at any rate considered reasonable in normal times.

(d) In the difficulty of obtaining equipment in reasonable times of delivery.

Each one of the above factors has a direct bearing upon the cost and quality of electric service and any one of them arising under normal conditions would demand careful consideration and treatment, but when all of these factors arise coincidently and are affecting an industry which has been operating under circumstances requiring for stability and success, the condition of steady and predictable markets for its purchases and sales, the results may be not only serious but even destructive if the appropriate measures of relief cannot be obtained.

The effects of the war conditions have already increased the operating expenses of the electric companies of this country to the extent of over $116,000,000 per year. This points to the necessity of readjustment to the new conditions without delay, while at the same time requiring readjustment to abnormal labor conditions.

Labor Conditions.

Any complete study of the effect of the increase in expense for operating wages and salaries on the operations of electric companies, caused by war conditions, is a difficult proceeding because every class of labor is represented, from the unskilled wage worker to the highest class of administrative official, and increases among these classes differ in their proportions, the highest paid men having received the smallest proportional increases, if any; also because the wages paid for the same kind of labor as well as the increases involved vary throughout the country. Moreover, the growth of companies and accompanying increase in output per unit of labor, improvement in organization and in the science of economic labor application have tended to continually reduce the cost of labor required per unit of output, that would otherwise be required to produce equal or improved results. Although individual salaries and wages have been gradually increasing during past years, the labor cost per unit of service had been decreasing prior to the war.

War conditions, however, have greatly affected this situation. The growing scarcity of labor in the ordinary occupations of peace, due to stoppage of immigration, demands for industrial workers for government work and drafts for the national service, together with the necessity for enabling employees to meet the increased cost of living and the competition for retaining some experienced employees and of obtaining new employees, all combine to increase wage and salary scales. The employment of women has enabled the electric utilities to obtain an additional class of labor at a relatively low rate, but when women take the places of men, more women employees are required than the number of men replaced, and the war condi-

tions tend to exhaust the supply of even this class of labor by offering wider fields of employment.

It is recognized that the labor cost to public utilities will further advance, either by increases in the direct wage or by some system of war additions such as are being employed by the other nations at war.

An analysis of the United States Census statistics shows that the increase in the average wages paid per employee (exclusive of general officers, managers and superintendents) during the ten years from 1902 to 1912 was 11 per cent. The actual increase in wages for like classes of labor may have differed from this figure, since the evolution of electric generation and distribution apparatus has shifted the relation of unskilled and skilled employees, but it plainly shows how abnormal are the sudden great increases in wages which have occurred as a consequence of the war.

During the war period thus far, salaries of officers, managers and general superintendents have in general not greatly increased, but increases in wages in the operating departments have ranged from 15 to 50 per cent and we are of the opinion that 25 per cent may be taken as the average increase.

The total salaries and wages paid to employees of electric companies throughout the United States make up about one-third of the total operating expense, including under the latter heading the cost of power purchased and the renewals and replacement expenses, but not interest on capital debt. Under normal growth from 1912, at the rate indicated by the growth during the previous ten years we find that the salary and wage disbursements of electric companies in the year 1917, had there been no unusual disturbance, should have amounted to $90,000,000, of which one-seventh would have been for general officers, managers and superintendents' salaries and six-sevenths for wages. From this it is seen that the increase in wages of 25 per cent means an outlay on the part of the electric companies of $19,000,000 for the year.

In the matter of retaining trained operatives, the Government's draft for war services and the war scale wages offered in industrial fields, both contribute to deplete the trained operating forces of the electric companies. We believe the Government will and should, as a matter of good business, not unduly hamper the carrying on of a service so essential to its needs, but many of the finest electrical employees have voluntarily enlisted and the draft has taken a share of trained employees.

This situation is already being felt not only in increased wage scales, but also in cost for training new operatives, and the continual change in employees will necessarily be reflected in a reduction in economy of operation and in some reduction in the quality of service not only in the supplying of power but also in the accounting departments, and in the new-business departments as far as they are maintained. The effects of this condition will become more and more apparent as time progresses, and the utilities must be prepared to meet the conditions of depleted forces and untrained operatives.

High Cost and Scarcity of Coal.

The electric utilities meet the largest single item of increased expense in the fuel account. The gross cost of fuel of a given quality is made up of cost at the mine, cost of transportation, and cost of labor for handling; and, due to differences in mining costs, length of haul and purchasing facilities on the part of the utilities, the gross costs as well as the increases have differed materially among the utilities and throughout the country. In addition to tremendous increases in costs per ton, the utilities are confronted with the necessity of accepting coal of inferior and non-uniform quality, which results not only in lower efficiency due to reduction in heating value, but also in lower efficiency incident to operating boiler equipments with continually changing grades of fuel.

The cost of fuel has an extremely important bearing upon the total cost of electric service. Estimates based upon the United States Census reports show that this item of expense for all the electric companies in the United States would have reached $50,000,000 for the year 1917 under normal conditions of the country, and would have amounted to about 60 to 65 per cent of the normal generating expense. Definite information as to the amount of increase in fuel cost for the whole country is not available, but from information obtained from various sections of the country, we arrive at the conclusion that on the average the cost per ton of coal to electric companies has increased a little more than 100 per cent on account of war conditions, and that 100 per cent is not far from correct. On this basis the increase of total cost due to the increased price per ton of fuel is $50,000,000. A conservative figure for the increase in tonnage due to lower quality and non-uniformity of grade is 10 per cent, which means an added increase of $10,000,000, making the total increase $60,000,000.

Reliability of service has already been adversely affected in some instances by the fuel situation, and the importance of maintaining continuous service especially in congested territory and in industrial centers producing war materials is obvious. The size of the reserve coal supply required to assure continuity of service is dependent upon the rate of use and the dependability, frequency and regularity of deliveries.

An estimate of the output from steam-driven electric central stations which might have been expected for 1917 under normal conditions shows 13,000,000,000 kilowatt-hours, and an average requirement of three pounds of coal per kilowatt-hour of output, shows the fuel requirements would amount to not over 20,000,000 net tons, which is approximately 3 per cent of the estimated output from the mines for 1917. It is thus seen that a relatively large reserve supply of coal in the hands of every electric company would tie up but a very small part of the coal supply of the country and this supply would be widely distributed over the country and to a certain extent would be in proportion to the populations and industrial importance of the several sections of the country.

Difficulties With Other Supplies and Resultant Reduced Economy of Operations.

The normal cost of materials and supplies other than fuel, used in operation and current maintenance of electric properties, makes up no small proportion of the total annual operating expense, which we estimate as a little over 15 per cent. The percentage increases in the cost of such materials and supplies due to war conditions have been enormous and extremely varied in amount and the determination of the average amount of these increases imposed on electric companies is very complicated, but the indications are that this amounts to as much as 75 per cent. Such an increase in this expense means an increase in expenditures in the neighborhood of $30,000,000 over normal expense for 1917.

The increase in the cost of materials and supplies may be expected to cause operating companies to curtail their repairs and current maintenance to the great-

est possible extent, but such reduction cannot be large if satisfactory quality of service is to be maintained. In the matter of supplies contemplated for improvements and replacements of plant, however, the difficulty in obtaining equipment in reasonable times of delivery and the abnormal cost of any equipment that may be required naturally points to the advisability, and in many cases the necessity, of retaining present equipment in service until the exigencies of the situation make a change imperative, even though under normal conditions it would be advantageous to make the changes promptly, thus introducing an element of reduced economy in operation which under normal conditions would not be present.

Protective Measures and Increased Taxes.

The measures which must be taken to protect property from malicious interference by enemy agents comprise the development and maintenance of effective protective structures and lighting systems as well as special policing. The large capacity of individual units of generating equipment and the large capacity of transmission circuits of today increase the necessity for thorough protection owing to the large amount of damage that could be accomplished by an enemy agent if given the opportunity. The government action in restricting the activities of the enemy alien population is an important safeguard in this connection, but the necessity for direct protective measures during the continuance of the war adds hundreds of thousands of dollars to the normal expense accounts of individual large electric corporations and runs into the millions in the total cost of service throughout the country.

In the matter of increased taxes we have purely a problem of caring for the increases over those of times prior to the war, and there is no way of predicting how large a factor this expense will become during the progress of the war or how far it will reach into the future. Estimates based upon the United States Census returns indicate that the 1917 taxes paid by electric companies might normally have reached $25,000,000. The proportion of gross revenue required for taxes has apparently been increasing year by year, having been slightly over 3 per cent in 1902, a little over 3½ per cent in 1907, and nearly 4½ per cent in 1912. Taxes on net income made up a very small proportion of the total tax in former years. This form of income taxation has had growing favor in legislative circles and is freely used by the Government in its war-tax program. An estimate of the amount of the expense which may be expected to be added to the cost of electric service throughout the country by the operation of the net-income-tax law is obviously dependent upon the effect of war conditions on net incomes, and the effects of "tax free" bond clauses and taxes on excess and undistributed profits clearly cannot be estimated. We may hazard a guess that the increase over normal tax expense will lie between $5,000,000 and $10,000,000 for the year 1917.

Summary of Known Increases in Costs.

Summing up the foregoing amounts shows that the extra expenses now imposed on the electric companies on account of war conditions amounts to the immense aggregate per year, as follows:

Increased salaries and wages chargeable to operating	$19,000,000
Increased cost of fuel	60,000,000
Increased cost of other materials and supplies	30,000,000
Increased taxes	7,500,000
Total	$116,500,000

This amounts to a quarter of the normal estimated gross revenue for 1917 of all the electric companies and it wipes out two-thirds of the sum that would have been available for interest, dividends and surplus. It does not include additional expenses caused by the difficulty of retaining trained operatives and the cost of protecting the properties against malicious interference, the magnitude of which we are unable to estimate. It puts the electric companies in a critical position, which is rendered more ominous by the impossibility of foretelling how much larger these extra expenses may become in future months.

It is to be expected that the American people will come to more fully appreciate the need for economies in every direction as the war progresses, and that their consumption of electric power for residential and ordinary commercial lighting will become materially reduced. This effect is now just beginning to be felt by the electric companies. It can result in only a relatively small reduction in the outputs of the electric companies but to that extent it will liberate generating capacity for use in war service and will conserve some fuel. It will, however, liberate relatively little distribution plant which can be used for war demands and will have substantially no effect upon total distribution expenses, so that a very large part of the reduction in gross revenue arising from such economies will appear as a reduction in the net income. As an economic consideration of the war such economies are to be earnestly encouraged, but it is nevertheless true that so far as the electric companies are concerned they mean reduction in net income almost equal to the amounts by which the gross revenues are affected. It is not possible to estimate what the effect of the companies' revenues will be except to say that it apparently will run into the millions.

Extensions of Plant.

The effects of the war conditions are being manifested not only in the matter of heavy increases in the operating costs already pointed out, but also in the matter of extraordinary increases in cost for new plant required to care for added business. At first thought it might be concluded that the effects of the latter apply only to the period of war, but the increased cost of new plant per unit of capacity manifestly affects the cost of service, not only for the period of the war, but for the life of such plant, unless some measures can be devised to amortize the excess first cost of new plant over the first cost in normal times.

Many electric companies are now confronted with the necessity of not only caring for their normal growth of business, but have had thrown upon them large demands for power arising from the increasing expansion in the manufacture of material of war, which includes almost every necessity of life, ranging from shipping to textiles and foodstuffs, in addition to special war products like arms and ammunition. On this account the electric companies have found themselves obliged to prepare very rapidly to meet increased power demands of several hundred thousand horsepower over their normal requirements.

Central Stations Logical Medium for Large-Power Supply.

When viewed from every standpoint, it will be seen that the economical central power-generating station is the proper medium for the supply of the large power requirements arising on account of the war, since purchased power leaves the manufacturers of

munitions and other war material free to devote their energies to the development and operation of their manufacturing plants without diverting any of their energies to the development of power plants or their operation; it provides the greatest possible amount of available power from a pound of fuel; it reduces the total capacity of power-generating equipment necessary by taking advantage of the diversity between the power requirements of the various manufacturing establishments; and it provides the greatest possible amount of available power per man occupied in the power-generation field and thus diverts the least possible man power from the other needs of the nation. It also makes it possible for the power-equipment manufacturers to concentrate upon the production of the larger units of equipment used by central electric stations, thereby making it possible to produce the largest capacity of equipment in the least time. And the centralization of electric power-generation equipment, with comprehensive distribution systems, places it in position to most effectively care for the changes in power requirements of industrial establishments to be expected after the termination of the war.

These advantages of the central-station power are so large that it is advisable for the Government to use every reasonable means to encourage the central-station companies and discourage individual power plants during the war period.

It is to be expected that much of the business arising from the war will prove of a temporary character, so that the electric companies are faced with the double dilemma of finding themselves called upon to provide capacity to care for extraordinary accessions of new business, at costs for the equipment and installation far above normal prices, and this in the face of the fact that it is to be expected that in many cases some of the business will prove of temporary nature without equivalent other demands to take its place after the war.

Government Measures Suggested to Meet Power Demands.

The electric companies have so far provided for the needs of the situation splendidly, but this has been done largely at the expense of reserve capacity, as the financing of almost no large extensions, if any, has been accomplished since our country became a party in the war. There can be no doubt that the power demands on account of the war have not yet nearly reached their maximum and it will be necessary to devise some way by which it will be possible to care for these demands.

This can be accomplished by the adoption and promulgation by the Government of certain war measures; one being to make possible the discontinuance or curtailment when advisable, particularly at the peak-load periods of the electric companies, of power and lighting demands not necessary for prosecution of the war or for the safety and reasonable necessities of the population, and another being for the Government to assume the responsibility for seeing that money for extensions required for war service can be obtained on reasonable terms. The first named measure would also operate in the interests of fuel conservation.

We may show the effect of war prices on the electric light and power business in the aggregate. The United States Census of central stations shows that the total of the revenues received from operation and other sources by all central electric light and power systems (including both hydraulic stations and steam stations) in 1912 was in round figures $302,000,000 and the total operating expenses, including taxes and renewals and replacement expense, but not including interest on debt, was $184,500,000, leaving a total income of $117,500,000. The reported cost of construction and equipment was $2,176,000,000. Extension of these totals to the present year 1917 shows that under normal growth the total revenues in 1917 would have reached $475,000,000 and the operating expenses, including taxes and renewals and replacement expense, would have reached $290,000,000, making the total income, before deducting interest on debt, $185,000,000. Estimating the reported cost for construction and equipment would have grown to $3,500,000,000, an increase of 60 per cent in five years, the above income would represent 5.3 per cent of this cost of construction and equipment. If no other factors entered into the problem besides increases in cost of operation, and assuming these increases effective over the whole year, the fuel expense, as before pointed out, would increase $60,000,000 for 1917, other supplies $30,000,000, labor expense $19,000,000, and taxes $7,500,000, representing an aggregate increase of operating expenses for these items of $116,500,000. This is an increase of 40 per cent in operating expenses, and it reduces the divisible income to $68,500,000, which amount is equivalent to less than 2 per cent on the cost of construction and equipment. This percentage is still lower in the case of the steam-electric systems of the country taken alone, and additional expenses for training new employees and the lowered efficiency of such employees, the cost of special policing, etc., reduce the amount still farther.

Possible Operating and Service Economies.

There are certain operating economies and changes which might be adopted by the companies, if forced to it by war conditions. The service rendered the customers might be curtailed, for example, by discontinuance of lamp deliveries and free minor repairs, by less prompt attention to troubles and complaints, thereby reducing the number of "trouble" employees, by bi-monthly or tri-monthly billing and the like; the canvassing and promotion departments might be almost entirely dispensed with, with consequent reduction in meter testing and setting expense; and advertising expense might be eliminated. In the storeroom, increased cost for material points to more than merely salvaging scrap material. It forces the use of old and shopworn supplies and non-standard equipment, and previously used wire and cables. While the use of such equipment may render the service less reliable, it may become an unfortunate necessity.

The net results of such economies might amount to as much as 10 to 15 per cent of the normal operating revenues of the electric companies, and every consideration should be given to them, but they are offset by increases in expense which have not been included in the amounts named.

There is a phase of the situation which has not been referred to in the preceding, but which in some cases is already being felt and is likely to be generally felt by electric companies. This is the improvement in load-factors arising from putting the less essential industries on an off-peak basis and the fact that war industries give an exceptionally long-hour demand, owing to the intensive character of war manufacture. This produces two quite distinct results, one being in the direction of reducing the maximum loads which may be carried, particularly on underground cables and to some extent upon generating equipment, and the other being in the direction of decreasing the ex-

pense, other things being equal, per kilowatt-hour of total output. How much effect the first result may have it is impossible to predict, but it may have marked effect in cases where the load-factors become very high, and it is already showing.

A part of the increased cost on account of war conditions has been provided for by many companies by the introduction of coal clauses in contracts for large light and power service. These clauses have taken various forms from the simplest in which the increased (or diminished) charge is figured at a given amount for each dollar of change from a stated cost of coal per ton, to the more elaborate form in which the increased charge is figured upon the relation between the present-day cost and the cost in a prior period for the coal required for performing the same amount of work.

But even if coal clauses could be satisfactorily applied to all electric rates, which they cannot, they would be only a partial remedy for the present conditions, since the increase in cost for coal is only about one-half of the total increase in cost due to the war conditions. Each electric rate requires modification to take into account the other factors as well as coal entering into the cost, so as to increase the total revenue approximately 25 per cent, in order to bring the same income to the electric companies of the country to cover interest and surplus as would have been expected for 1917 under normal conditions. It should be noted, however, that a correctly adjusted coal clause more fully meets the situation for contracts with high-tension customers than with the general average of small customers in serving which there are large expenses for labor and materials required in the processes of transpormation and distribution.

Conservation of Fuel by Central-Station Power Supply.

Considering the output of power by the industrial plants using steam power, which do not now purchase electric current, estimated on the basis of the capacity of equipment as reported for 1914, operating at the equivalent of full load for a sixth of the time, the total horsepower output would amount to 23,000,000,000 horsepower-hours. It is safe to say that at least three-quarters of this is such that the exhaust steam cannot be effectively used for heating purposes and there would be a possible saving of at least 1½ pounds of coal per horsepower-hour through service of this three-quarters from central steam-driven electric stations, making a total saving in fuel of 13,000,000 tons of coal per year under the industrial plant output for the year 1914. The saving would be much greater when considering only the more modern and economical central stations. The same considerations as above apply to the field of isolated building and hotel electric plants where conservation of coal amounting to millions of tons could unquestionably be effected.

We have heretofore given principal consideration to the effect of war conditions as increasing the demands for service. We have not as yet in this country much experienced the opposite effects of economies forced by war conditions. In England, the danger from air raids and the necessity for conserving coal have materially decreased and in some cases almost wiped out the street-lighting service furnished by many companies, and government regulations, together with economies practiced by the customers, have very materially reduced the domestic and commercial lighting loads. It is obvious that such losses of business, coupled with increased cost for supplies and labor, increase the expense per unit of output far beyond the point where it may be neutrilized by any economic practices of the supplying company. The result has been quite a universal increase in rates, in some cases flat percentage increases of the same amount for light and power, in other cases differing percentage increases for light and power, and in still others increases depending upon changes in cost of fuel

As to the effect of war conditions in this country on ordinary domestic and commercial light and small-power consumption for other than manufacturing purposes, the rate of adding new residence and commercial customers is on the whole falling off, due to personal economies of the public and generally fewer extensions of lines by the companies and to decrease in building activities and the like. It does not appear that the lighting customers in this country have as yet inaugurated any general lighting economies sufficient to be seriously felt by the companies, and the companies have, on the other hand, shown a disinclination to increase the rates to small consumers. The drain on our resources will, however, be felt more and more as the war progresses, and it is to be expected that the domestic and commercial customers will decrease their consumption of current.

Conclusions.

It is evident that increased expense for service arises in every department of the business; in operating labor and supplies and taxes, in protection of the property, and in cost for extensions of plant. And the latter is not only affected by abnormal first cost for equipment and its installation, but also by the present difficulty of obtaining money for such purposes at other than exorbitant rates as compared with normal. In the matter of labor expense the cost of service is increased not only on account of increase in wages but by the need for training new employees to the service and the necessity of operating with partially trained employees.

The increases in cost of electric service on account of the war conditions are so great that rates for service, which were equitable at the beginning of the war, are in some cases now not covering the operating expense, and where companies are being loaded with war business the new business in many cases may become a serious menace to the company, which can only be overcome by taking into account the war conditions in determining the rates to be charged.

Notwithstanding that wages of operating men are higher than ever before, yet the necessity for using many partially trained men in the operation and inspection of electrical systems makes for a lowering of reliability for service and this, coupled with the need, in some cases, to utilize all equipment to its limit with reduced reserve capacity, has a further effect in this direction as well as in the direction of reduced operating efficiency. Also it is to be expected that with present conditions, added transmission lines will not be installed if the present circuits can possibly carry the loads, even though under ordinary conditions additional circuits would be promptly provided, and like considerations apply to distribution systems with a consequent tendency toward reduced efficiency and a wider range of voltage variations than is now considered good practice. It seems proper that regulatory bodies should take into account these considerations in their requirements for electric service during the period of the war.

Editorial Comment

War Problems of Central Stations

WAR is no respecter of persons or industries. We all are alike in being compelled to bear its burdens as best we may. Likewise, the electrical industry in common with all others is facing problems that are not only new, but serious enough to require the most careful consideration. What is true of the electrical industry as a whole is true of its various branches, and particularly of the central station, electric traction, telephone and telegraph fields. These electric utilities have many war problems in common, those of the central stations being broadly typical of them all.

A masterly presentation and analysis of central-station war problems has been made in the paper by Lynn S. Goodman and William B. Jackson, read before the unique three-city January meeting of the American Institute of Electrical Engineers. The subject being a national one, it was peculiarly appropriate that the excellent custom followed by the Institution of Electrical Engineers in Great Britain of holding what are practically national meetings was adopted for this occasion. The interests of the central station have been affected in so many ways by the war and the difficulties in the way of supplying electric service on the same basis as before the war are so great that the broad-gauged analysis of the situation made by Messrs. Goodman and Jackson is especially timely and valuable. For the benefit of those of our readers who are not members of the Institute, we reprint the paper in slightly condensed form on other pages of this issue. The problems involved are probably more of an administrative and financial character than pure engineering, so the authors are to be congratulated on making so thorough a study of the subject from the engineer's viewpoint.

The authors point out a dozen principal difficulties that the central stations are now confronting, which may be regrouped or summarized into the following. Increased cost, averaging about 40 per cent, of almost every element of operating expense, especially fuel, labor, miscellaneous materials and supplies, and taxes; increased cost and difficulties of making extensions to plant and of financing them; increased uncertainties of the business, such as possible changes in load-factor and reduction in consumption due to war-time economies by ordinary customers.

No single panacea can be applied for the solution of so many difficulties. Even very large increases in rates to more than offset all the increased costs will not make it possible to overcome those difficulties of operation and plant extension that are not questions of cost. Instead of trying to find a single cure, the authors show that there are numerous remedies which already are being and will have to be applied. Among these are many economies of operation, restriction of new-business activities, and elimination of gratuitous services; placing of non-essential power customers on an off-peak basis; increase of certain rates and use of coal clauses in power contracts; governmental guarantee of reasonable terms in financing extensions. The discussions brought out at the different meetings show that these and other various partial remedies are proving quite effective in meeting the situation without resorting to wholesale and flat increases in rates. Financing of new extensions is in many cases being done by the prospective power customers. Systems are in many cases being interconnected for mutual advantage. The labor shortage is being met by employment of women, girls and boys. Free repair work and free lamp renewals are being discontinued. Meter reading and billing is being done at two or three-month intervals. Peak loads are being cut down and distributed over the low parts of the load curve. Coal is being used more economically.

All these efforts at meeting the problem by a little give and take here and there are more praiseworthy than those expedients that are radical departures from approved central-station policy and practice. It is to be hoped that the Institute paper under discussion will serve to arouse those central-station men that have so far been prone to throw up their hands in despair to renewed consideration of other means of adapting their industry to war conditions. By thoughtful and concerted action not only will the industry overcome its many troubles, but come out of the struggle with greater strength than it ever had before.

Routine Testing of Current Transformers

THE current transformer has long been recognized and universally adopted as the medium by which alternating currents of any magnitude and at any commercial potential may be conveniently, safely and inexpensively measured; and through the use of which one meter may be used for an almost limitless range of currents by merely changing the constant of the meter. Accurate metering of station outputs and energy consumed by various customers is necessary on the score of both economy of operation and determination of income. Moreover, many state and civic authorities require that metering accuracy should not vary either side of definite limits. Without knowledge of the amperage flowing in circuits and machines or the energy or apparent energy between systems and units, equipment may be overloaded and destroyed.

Therefore, accurate knowledge as to the current flow is a sine qua non in the generation, transmission and utilization of electrical energy.

The increasing number of customers going over to centralized electrical supply, the use of bulk power, long hours and heavy loads, makes accurate metering more than ever necessary in the interests of the consumer as well as the company supplying him, for protecting the expense of the one and the income of the other. The preparation of the equipment for large metering installations, while admittedly important, is not always an easy matter these days where skilled labor is scarce and where, moreover, labor is continually on the move. Test methods should therefore be simple, such as are easily learnt, and that may be carried on with rugged and simple commercial apparatus rather than with delicate and expensive apparatus used for complicated methods.

Elsewhere in this issue will be found described a simple method of testing current transformers for phase angle and ratio without the rather numerous, complicated and usually delicate equipment and somewhat involved methods often employed. The characteristics of the unknown transformer are checked against those of a standard transformer of the same nominal ratio and of known constants. The method requires a current transformer of known characteristics, a commercial wattmeter and voltmeter such as are usually found in every central-station meter department or laboratory. The method is fairly simple, and may be used without much trouble by the average meter man; it is rapid and thus may be found convenient where labor is short and the number of current transformers to be tested is considerable or the time for doing it is short. Moreover, it is a method that can be used where only commercial instruments and apparatus are at hand, a method that on this account comes within reach of every central-station company down to the smallest.

"Daylight Saving" and Reduction of Peak-Load Service

CONGRESS in all probability will enact a "Daylight Saving" law in the near future, based on the plan put into effect in some dozen European countries since the war began. Reports from overseas state that the plan has been quite successful as a war measure by utilizing an additional hour of daylight during the five summer months, which has been greatly appreciated by the public in general as well as by all interests that are putting forth every possible effort to winning the war. As a means of conserving coal and expense involved in the use of artificial light the plan has resulted in some economies, but their magnitude has not been as great as was expected.

While the matter is still under consideration in this country, the shortcomings of the "Daylight Saving" plan are being presented to the congressional committee that is to report on the measure. The consensus of opinion seems to be, if press reports from Washington are to be relied on, that the objections of the railroads, who have been the most strenuous protesters on the score of safety, will be overcome by the evidence from abroad that no serious accidents resulted from the necessary changes in train schedules. Since the enactment of the plan seems quite certain, a timely amendment of it has been suggested by Samuel Insull, chairman of the Illinois State Council of Defense, and one of the best known electric central-station men in the country. He advocates an extension of the plan throughout the year with the idea of creating a greater diversity between the daily power and lighting loads and thus decreasing the costly peak in central-station load curves. This idea is worthy of serious consideration since it will result in the saving of much more coal than "Daylight Saving" during the summer and will place a great deal of efficient central-station plant at the service of many factory and building owners who now maintain inefficient plants of their own.

It is unfortunate that this broadened scope of "Daylight Saving" was not brought forward earlier, for it takes considerable agitation for a movement of this kind to be understood and its merits appreciated. Should it fail to be included in the pending legislation, the central stations still have recourse to the offering of special off-peak rates aiming at more definite valley filling of the load curve as well as reduction of the present winter peaks.

A plan that is especially worthy of being pushed is the creation of greater diversity in the hours of opening and closing of factories, large stores, offices and other important places of employment. This matter was discussed in these editorial columns in the issue of January 23, 1915, the plan being advocated especially as a means of eliminating the objectionable rush-hour traffic on urban traction lines. Not only would it have the effect of improving the load-factor of electric traction companies, but also of central stations, lunch rooms and other utilities that serve large establishments and their employees. Through co-operative action by such civic bodies as boards of trade and associations of commerce the numerous merits of this plan could be more readily impressed on the large industrial and business interests. The urgent need of conserving all the nation's resources during the present struggle and the necessity for making more intensive use of all present equipment because new equipment is now practically out of the question, should make this an especially appropriate time to bring about this much desired reform.

Extraordinarily heavy snowfalls in the last two weeks have choked the streets of many of our cities, impeded pedestrian, vehicle and automobile traffic, and made the electric traction lines almost the only means of passenger transportation available. The resulting crowding of street cars, elevated and subway trains during the rush hours has been almost inhuman and has served as a forcible example of the need of spreading out the peak load as suggested.

Week's Events

Ohio New-Business Men Meet—Report of American Institute Meeting—Other Reports and News of the Industry

OHIO NEW-BUSINESS MEN HOLD MEETING.

Industrial Power Subjects Discussed at Dayton—Banquet in Evening.

In spite of the difficult transportation conditions, there was a large attendance at the meeting of the New-Business Co-operation Committee of the Ohio Electric Light Association, which was held at Dayton, January 16. Frank B. Steele, power engineer of the Dayton Power & Light Company, who is chairman of the Section, presided. Judge E. P. Matthews, vice-president of the Dayton Power & Light Company, delivered the address of welcome. He talked on general business conditions and on benefits derived in communities having ample reserve central-station capacity to take care of unusual demands. He urged that every citizen do his utmost to help win the war.

Dwight D. Miller, of the Society for Electrical Development, presented a paper on "Low-Temperature Industrial Heating," dividing same into seven sections. He advocated intelligent action respecting operations involving the use of heat, which can be more profitably carried on by means of heat electrically generated. Discussions on this subject followed by C. D. Carlson, of Cleveland, and C. I. Crippen, of Youngstown.

Mr. Steele presided at luncheon, at which the speaker was George C. Smith, chief of industrial surveys of the Baltimore & Ohio Railroad, who was introduced by Thomas Kelly. Mr. Smith's subject dealt with industrial surveys for intensified service, tending to the commercializing of railroad business. He advocated that the railroads should be made to occupy the same position to the public as the central stations.

The afternoon session was opened by C. A. Winder, of Niagara Falls, of the General Electric Company, presenting an interesting paper on the uses of electricity for the manufacture of chemicals. A discussion on this followed, in which Mr. Whittington, of Springfield, C. D. Carlson, of Cleveland, and C. I. Crippen, of Youngstown, took an active part. In his paper Mr. Winder cautioned the central stations to guard against the likelihood of their losing the electrochemical business that they are now enjoying at the close of the war. R. L. Yates, assistant manager of the Platt Iron Works, Dayton, presented a paper entitled "Water Pumping by Electricity." This was discussed by F. H. Hooper, of Van Wert, Ohio, W. S. Scott, of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., C. I. Crippen, of Youngstown, and Dwight Miller.

The banquet in the evening, which was given under the auspices of the Dayton Electric Club, was attended by nearly 200 members and visitors, and was under the direction of Chairman Steele. R. W. Baggott, Judge of the Court of Domestic Relations, Dayton, was toastmaster. In the absence of J. W. Lieb, who was unable to attend, Paul M. Lincoln substituted, delivering an address entitled "The Electrical Industry in the War."

BROOKLYN COMPANY SECTION HOLDS ANNUAL MEETING.

T. I. Jones Delivers Principal Address Reviewing Developments During 1917.

On Tuesday, January 15, T. I. Jones, general sales agent of the Edison Electric Illuminating Company, of Brooklyn, N. Y., gave his annual address before the members of the Brooklyn Company Section of the N. E. L. A., upon the subject, "Development of Our Business During the Year 1917."

Another interesting feature of the program was a short talk by W. F. Wells, vice-president and general manager of the company. Mr. Wells confined his remarks to the exigencies of the war as related to their business, with an urgent appeal to the members to do their part in the war savings thrift campaign.

Preceding the meeting, a dinner was given to a number of out-of-town guests at the Crescent Athletic Club. Those present at the dinner were H. M. Crist, W. J. Clark, W. H. Onken, Jr., Louis Wintner, D. F. Atkins, M. S. Seelman, Jr., H. P. Erwin, Myer Hurley, F. Pratt, P. B. Parker, C. A. Barton, J. N. Harman, George Weiderman, R. G. Henderson, H. H. Barnes, G. J. Leibman, E. A. Baily, O. H. Caldwell, A. D. Page, H. W. Young, A. A. Brown, P. D. Honeyman, C. G. M. Thomas, Ray Palmer, T. I. Jones, S. D. Sprong, R. J. MacDonald, J. A. F. Randolph, G. O. Osborn, W. F. Wells and H. P. Wood.

The meeting was held in the Y. M. C. A. Auditorium and the house was filled to capacity. Every one enjoyed Mr. Jones' talk, which, as is characteristic of his addresses, was plentifully illustrated with lantern slides. A very good entertainment program had been prepared, which was well presented and thoroughly enjoyed.

EFFECTS OF THE WAR UPON CENTRAL-STATION SERVICE.

Timely Paper by L. S. Goodman and W. B. Jackson, Discussed Before American Institute of Electrical Engineers in Triple Meeting.

With increased costs of fuel, supplies, labor and taxes, occasioned by war conditions and amounting to more than $116,000,000 over the operating expenses that should have been expected for central-station companies under normal conditions during 1917; with inability on the part of the companies to raise rates to correspond to these increased costs; with certain classes of revenue decreased; with power loads in many cases greatly increased; with serious difficulties in financing extensions and needed betterments, and with other conditions presenting grave problems, the

outlook in the central-station business is disquieting. These were some of the points brought out in the paper by Lynn S. Goodman and William B. Jackson, presented at the 336th meeting of the American Institute of Electrical Engineers, which was in the nature of a triple meeting held on January 8 in Boston, January 11 in New York, and on January 14 in Chicago. At each gathering the paper was presented in abstract by Mr. Jackson, who emphasized the serious nature of the problems confronting the central-station industry. This paper is reprinted, in slightly condensed form, on other pages of this issue.

At the principal meeting held in New York, President E. W. Rice, Jr., presided. After Mr. Jackson had summarized the leading features of the paper, Secretary Hutchinson briefly abstracted three written discussions which were sent in. One was from F. A. Bryan, president Indiana & Michigan Electric Company, South Bend, Ind., who pointed out that numerous hydroelectric companies like his had added new industrial power customers on account of the high cost of fuel which drove many to seek central-station service. This had made it necessary to utilize steam reserve plants more extensively, which on account of high fuel costs raised operating costs greatly, although no increase of rate was possible. He believed that regulatory commissions should adjust these matters promptly. Prof. Ralph C. Hudson, Massachusetts Institute of Technology, also believed that regulatory bodies should appreciate the necessity of rate adjustment to meet the conditions. The third written discussion was from Mortimer Freund, New York City, who said the central station is a vital feature in our economic system and the Government should encourage all users of fuel who could show least waste. The private plant in some cases might show up even more economically, in which cases it should be encouraged similarly.

Col. Bion J. Arnold was called upon and was very warmly received by the audience. Drawing more particularly on his railway experience, which all has its bearing on the central-station situation, he spoke of the coal situation as most threatening. One large railroad company in the East, using electric power, was recently within three hours of having to shut down for lack of coal supply. Railroad transportation is the greatest thing that confronts us. The steam roads are learning in this great crisis the advantage of coordination in the utilization of all facilities. They will never go back, in Col. Arnold's opinion, to the plan of competing with each other in the matter of trying to rush side tracks into every new industry almost before the factory buildings are built, and in this way encouraging the multiplication of spurs and sidetracks in large cities into a confusing network. There will be system to it after this. The isolated plant he believed to have the advantage of the central-station plant only in cases where the steam can also be utilized in some manufacturing or other process with which the plant is identified.

Philip Torchio, chief engineer, New York Edison Company, said that we hear much about the utilization of water power at this time especially. This power should, of course, be developed to its greatest extent. But the power so developed should be utilized as far as possible for what might be called national purposes, such as operation of railroads, furnishing current in bulk for great enterprises like the electrochemical industries, etc. There is not enough water power for all purposes, so the steam plant is here to stay and its development and use of increasingly efficient methods must be encouraged. Some 270,000,000 tons of coal were used in 1915 in developing primary power. An equal quantity was used in the production of heat alone. In all the states east of the Rocky Mountains there is not enough water power to supply the present primary power demands, so it is obvious that with the development of the country the large steam plant must grow also, regardless of water-power development.

Discussion at Chicago.

The Chicago meeting was presided over by R. F. Schuchardt, who stated that the paper illustrates how an engineer can make a thorough analysis of a very complicated and seemingly non-engineering subject. Although the picture presented by Mr. Jackson was a very gloomy one, there were bright sides to the problem. Consideration of the entire matter presents new problems for the engineer and involves a greatly enlarged scope of his activities.

A written discussion submitted by F. D. Bartlett, of Philadelphia, Pa., was abstracted. This related to the labor situation in central-station systems. The labor turnover of large companies has become critical, due to labor unrest, military service and other war conditions. Mr. Bartlett cited startling figures on this point. The cost of teaching new employees in such a highly technical branch is very serious and suggests that utmost efforts be made to keep trained employees in service. The experience of several companies in the employment of women, girls and boys was narrated. Possibly the principal solution of the labor problem was to rely on heads of departments to keep in closer touch with their trained staffs, in order to hold them. Mr. Bartlett also called attention to the importance of vocational training, the need of which is now more keenly felt than ever.

F. A. Coffin, of Milwaukee, Wis., spoke of the increasing difficulty of financing extensions. The situation requires the making of new rules and customers must be expected to help finance necessary new work. The sales work of the Milwaukee central-station company, although greatly restricted, has resulted in almost as much increase in load as usual. Modifications are evidently required in certain features of central-station service, such as elimination of gratuitous engineering advice, trouble work, etc. "Lightless" nights have been found not to be an important factor in conservation of fuel. Mr. Coffin recommended voluntary inspection service of factory plants to suggest improvements for better conservation of fuel.

D. W. Roper spoke of the changed attitude regarding the importance of continuity of service and the value of making extensions. Both these points are looked at in an entirely new light: whereas extensions were formerly made if the anticipated revenue within two years was equal to the cost of the line, now revenue of one or two months must be equal to the cost. Other economies are being effected. It is no longer the custom to send out trouble men to replace fuses and make free repairs to sockets, switches, etc. Such service is charged for at the rate of 35 cents an hour. The free delivery of lamps will also be eliminated in the near future. Mr. Roper drew a curve, showing the number of hours that various loads are used annually; this showed that one-third the total investment in the plant produces only one-half of 1 per cent of the total output per year. It is evident that by cutting off peak loads this nonproductive third of the investment can be utilized much more advantageously. He suggested shifting of the hours of employment so as to reduce the peak and give a better diversity-factor.

A written discussion by William Gorsuch, of New York, was abstracted. In this the author analyzed the increase in three principal elements entering into the cost of production; labor has increased on an average about 55 per cent, supplies and repairs about 90 per cent, fuel about 70 per cent. At the same time the quality of the coal has greatly deteriorated. The most urgent need at the present time is to develop everything possible to increase the efficiency of coal consumption.

George H. Lukes felt that central stations must be optimistic and make the most of the situation. Shifting of the load due to changed hours of employment in the leading industries has important possibilities. Respecting the labor situation, the employment of women and disabled soldiers, returned from the front, may be the solution. C. W. PenDell said that the sales forces of central stations are now called on to keep power loads from increasing, rather than to develop new business. Prospective users with large power demands must meet such requirements as are necessary under the conditions prevailing and they must partly or entirely finance additional line and plant required.

C. A. Keller gave many figures on the increased value of central-station apparatus and equipment compared with pre-war prices. The weighted average shows an increase of about 43 per cent. F. H. Bernhard spoke of the magnitude of the problem and showed that no single nor simple solution was available. He emphasized the value of the proposed shifting of hours of employment, which would benefit not only the central stations, but electric traction lines as well. A. Honegger thought it would be necessary to raise rates in order to meet the increased costs. Respecting financing, he noted that farmers are becoming investors in utility securities and that many companies are selling their securities to citizens in the communities they serve. Among others who discussed the subject were T. Vladimiroff and J. W. Mabbs. The written discussion presented by F. A. Bryan, R. G. Hudson and M. Freund already referred to in the report of the New York meeting was also presented.

The discussion was closed by Mr. Jackson, who felt that the situation had assumed such proportions that the people are beginning to see the basic facts and to overlook petty things, such as politics, which formerly beclouded proper consideration of utility questions. Therefore, rate increases are being granted without much difficulty. It can be stated confidently that the problem will be solved satisfactorily.

ELECTRICAL INSPECTORS TO HOLD WAR CONVENTION.

Western Association of Electrical Inspectors Will Hold Three-Day Conservation Meeting at Memphis, Tenn.

The thirteenth annual convention of the Western Association of Electrical Inspectors, to be held at the Hotel Gayoso, Memphis, Tenn., on January 29 to 31, will be designated as the "Win-the-War Meeting" with conservation as its keynote. The program has been prepared for a series of interesting sessions and it is hoped that a considerable number of electrical inspectors and others interested in good construction, especially in the view of the need for conserving all resources of the country, will attend.

The first session on Tuesday will be opened by addresses of welcome, address of the president, and reports of executive officers, followed by an address by J. F. Joseph on "Conservation"; A. R. Small, Chicago, will speak on "Underwriters' Laboratories and the Great War," and E. Wanamaker will discuss "Safe Electrical Equipments for Oil Refineries."

At the afternoon meeting it is expected to have a number of addresses on the use of electricity in war work. Among these will be one by W. C. Johnson, of Memphis, on "The Use of Cotton in the Production of War Munitions," and W. E. Clifford will discuss "The Use of Forest Products in the Production of War Munitions."

The session on Wednesday morning will be a symposium on "Rational Economies in Grounding"; C. K. Chapin, of Memphis, will present the central station's view; C. B. Rutledge, of Memphis, will discuss the electrical contractors' view, and a representative of the Bureau of Standards will present the views of that organization. W. F. Dunbar, Atlanta, Ga., will speak on "Pioneer Electrical Inspection in the South." J. W. Kelly, Jr., Camden, N. J., will explain what the fire-alarm superintendent can do to help in the war. L. S. Keilholtz, Dayton, Ohio, will present a paper on "The Farm-Lighting System and War Service."

The remainder of the sessions will be taken up with reports of the regular committees, discussion of inspectors' problems and routine business of the association. On Friday inspections will be made of a very large electrically driven drainage pumping station and of the Memphis waterworks system.

"DAYLIGHT SAVING" PLAN ADVOCATED FOR ENTIRE YEAR.

Samuel Insull Shows That Conservation Would Be Promoted by General Adoption of Plan.

The Congressional Committee on Interstate and Foreign Commerce is considering several bills for advancing clocks one hour during the summer months and thus effecting the so-called "daylight saving" that has been followed in quite a few European countries since the war began. There is every prospect that one of these bills will be passed by Congress in the next month or two. While the subject is being considered there is a feeling among quite a few central-station men that the plan should be broadened to be effective throughout the year. This matter was presented in a telegram sent to the chairman of the Congressional committee by Samuel Insull, chairman of the Illinois State Council of Defense, and president of the Commonwealth Edison Company. Mr. Insull said:

"I understand a daylight saving bill is to be considered by your committee. We estimate that daylight saving, if effective for five summer months, would save the electricity industry in Chicago about 15,000 tons of coal per annum, or for the entire country 230,000 tons of coal. It would save the electric light consumers of Chicago $365,000 and of the country about $7,500,000 per annum, this being a loss of income to the lighting companies, with coal the only offsetting saving.

"If daylight saving is made effective throughout the year, the day power load and evening lighting load will not overlap to as great an extent as at present, thus avoiding the sharp peak in load and thereby releasing plant investment for other purposes and making a further saving in coal. Otherwise it would be necessary to fire up additional boilers to cover this peak for a short time each day in the winter months."

Mr. Insull then points out that with all-year daylight program, while saving about the same amount of coal and on lighting bills to consumers, "the effect on

lighting companies would practically be offset by the improvement in load-factor because of the reduction in winter peak, thus making a real economic all-round saving to the nation."

He added that "there would be some further similar, although smaller, savings in the gas industry, in isolated electric plants and in the use of other illuminants. The advantage of the year-round change, compared with the change in the summer months only, was probably not understood or presented in England. This country should reap the full advantage if a change is to be made.

"I am not familiar with the Borland bill, but the Calder bill provides for summer months only. While I favor as a war measure the passage of the bill covering the change for summer months only, if that is all that can be put through at this time, from my experience as a utility operator I very much more strongly advocate a change in time the year round, as that means more available plant capacity throughout the country, which is quite as important as coal in the present emergency."

NEW YORK JOVIAN LEAGUE HOLDS ANNUAL MEETING.

Officers Elected and New Committees Appointed for Ensuing Year.

The New York Jovian League held its annual meeting at Stewart's in New York on January 8. The following officers were elected for the ensuing year:

President, J. M. Wakeman, of The Society for Electrical Development.

Vice-president, George Williams, of Henry L. Doherty & Company.

Vice-president, H. A. Pratt, of Westinghouse Electric & Manufacturing Company.

Secretary, F. M. Feiker, of the Electrical World.

Treasurer, L. L. Strauss.

Directors, James Betts, of Betts & Betts; F. H. Leggett, of Western Electric Company; F. S. Hartman, of General Electric Company; J. R. Pollock, of New York Telephone Company; J. R. Strong, of Tucker Electrical Construction Company, and Arthur Williams, of New York Edison Company.

The President appointed an Advisory Committee to work with the Board of Directors in formulating plans and carrying on the activities of the League. The following were appointed: Chairman, James R. Pollock, of New York Telephone Company; vice-chairman, Frank E. Watts, of Hart Manufacturing Company; H. W. Alexander, of The Society for Electrical Development; Earl E. Whitehorne, of Electrical Merchandising; A. S. DeVeau, of Stanley & Patterson; J. W. Jones, of New York Telephone Company; Elliot Reid, of Westinghouse Lamp Company; Martin Oberlander, of Western Electric Company; Walter Neumuller, of New York Edison Company; J. J. Raftery, of Western Electric Company.

A resolution was adopted tendering the thanks of the organizations to Arthur Williams, president during 1917.

The speaker of the day was the Honorable Theodore E. Burton, former United States Senator and Executive Commissioner of the Inter-Parliamentary Union, in which capacity he attended the meetings held in London, Paris, Geneva and The Hague. Senator Burton's address was extremely interesting and dealt with the United States' participation in the world war for humanity.

A meeting of the Board of Directors was held immediately after the adjournment of the annual meeting. Plans were discussed for the Jovian Rejuvenation, to be held during January. The Advisory Committee will meet in the course of the next few days to discuss plans for the ensuing year.

THE TELEPHONE IN THE WORLD WAR.

Progress to Be Described Before New York Electrical Society on January 24.

Continuing the War Series of meetings that have been running during the winter, the New York Electrical Society announces another of timely interest for Thursday evening, January 24, to be held in the Engineering Societies building at 29 West 39th Street.

On this occasion the address will be "The Telephone in the World War." It will be delivered by H. J. Carroll of the New York Telephone Company's lecture bureau. He will describe the almost unbelievable work that is performed in the trenches, and elsewhere in the war area, by this electric conveyor of the spoken word. So that the listener may more easily visualize the marvelous achievements of the telephone on the battlefield, Mr. Carroll will project some enlightening and actual photographs upon the screen. These have been carefully selected and for those who attend, an opportunity is presented to see and hear something "new" in the way of war wonders.

EXTENDED POWERS FOR MUNICIPAL UTILITIES ASKED.

New Jersey Legislature to Consider Bills to Permit Interconnection of Neighboring Municipal Plants.

Through the efforts of the city officials of Madison, N. J., and neighboring communities, two bills are being prepared for presentation at the present session of the State Legislature, recently convened, to broaden the scope of activities of municipal utilities in the state.

The first and most important measure provides for co-operation between municipal lighting plants in neighboring vicinities, going so far as to authorize the combining of service to allow one community to furnish electric light and power for another, and vice versa, without becoming a public utility in the full meaning of the term and falling under the jurisdiction of the Board of Public Utility Commissioners and its control of bonds, franchises and rates of service.

In connection with this proposed law, it is interesting to note that the city of Madison has been seeking permission to use its plant for the benefit of the city of Chatham, a neighboring community, also operating a municipal power station. In this, to conserve the fuel supply, the Madison plant would carry the heavy afternoon and night load for both boroughs, not only for street lighting, but for private consumption, with the Chatham plant operating at other periods of the day, for the benefit of the two communities, when the load was light. In deciding this case, the Board of Public Utility Commissioners ruled that such an arrangement would make both stations amenable to its jurisdiction in all phases of operation.

The second measure to be introduced at the Legislature covers the granting of permission to municipalities to sell electric energy outside of the city limits, placing all lines and other equipment outside of such municipal boundaries under the jurisdiction of the Utility Commissioners, but excluding the plants as being considered as public utilities insofar as their strictly intra-municipal service was concerned.

Commercial

Figures on Lighting Campaign—Examples of Economy of Central-Station Service—New-Business Activities at Dayton

LIGHTING CAMPAIGN FIGURES AT DOHERTY PROPERTIES.

Fixtures Sold Total 5600 of a Merchandising Value of $89,600 and a Wattage Increase of 452 Kilowatts.

The new-business department of the Doherty Organization inaugurated a campaign for additional commercial and factory lighting on March 1 of last year, terminating December 1, in charge of R. J. Kennedy, illumination specialist, and a report of the accomplishments was recently made public. The result was so successful that Mr. Kennedy will soon start on a similar tour of the southern properties.

The number of new fixtures installed because of this campaign in nine properties was 5600, of a merchandising value of $89,600, and with a wattage increase in three properties—Toledo, Massillon and Alliance, O., of 452 kilowatts. These installations were all in excess of 300 watts.

The detailed figures follow:—

Company.	No. of fixtures	Merch. value.	Wattage increase.
Toledo	4,000	$64,030.00	349.431
Massillon	500	8,000.00	88.270
Alliance	100	1,600.00	14.600
Joplin	200	3,200.00	.....
Sedalia	100	1,600.00	.....
St. Joseph	400	6,400.00	.....
Salina	100	1,600.00	.....
Hutchinson	100	1,600.00	.....
Athens	100	1,600.00	.....
Total	5,600	$89,600.00	452 K.W.

The new-business department also announces comparative figures for the first eleven months of 1917. In this period appliance sales totaled $1,653,619 as compared with 1,127,830 for the first eleven months of 1916. With December to hear from it is estimated that 1917 will show a total of $1,800,000.

Purchased Power Shows Saving in Muskegon Foundry.

The Standard Malleable Iron Company, Muskegon, Mich., manufacturers of malleable castings, has found the use of purchased power much more economical than its former steam equipment. This plant uses central-station energy at 440 volts for the operation of 20 alternating-current motors of an aggregate capacity of 360 horsepower. In order to meet a possible emergency in power supply, a 140-horsepower Corliss engine, direct-connected to an alternating-current, 100-kilowatt generator, is held in reserve. A 40-kilowatt direct-current generator is operated for charging storage batteries. A number of storage-battery trucks are used for foundry and yard haulage; also a storage-battery tractor, equipped with Edison battery, is employed for hauling cars of castings. The shops, foundry and yards are illuminated by 60 200-watt mazda C lamps. The one 500-kilovolt-ampere transformer receives energy at 7200 volts, stepping it down to 440 volts for plant motors. Power consumption here amounts to 50,000 kilowatt-hours per month, supplied by the Consumers Power Company.

MOTOR SUCCESSFULLY REPLACES STEAM ENGINE.

Installation at Plant of Cleveland Hardware Company Effects Decided Economies—Results of Operation.

A striking example of the successful replacement of a steam engine by an electric motor is furnished by the installation in the plant of the Cleveland Hardware Company, Cleveland, Ohio. This company manufactures drop forgings for automobiles and similar classes of service.

For a period of 35 years the company had been operating a nine-inch merchant rolling mill belted to a steam engine which by this time had outlived its usefulness, and it was necessary to install a new drive, as the breakdowns were becoming frequent. The company was forced to consider a new driving unit. After a careful investigation of the subject, the unanimous decision was that an electric motor was the only logical solution of the problem, the wisdom of which has been more than justified by the entire absence of any trouble since the installation and an economy of operation better than was anticipated.

A feature of particular interest in connection with this installation is the purchase of electric power for the operation of the mill from the local lighting plant, the Cleveland Electric Illuminating Company, at a price which is far more reasonable than could be obtained by means of a privately owned plant.

Since the installation of electric drive, there has

Wound-Rotor Motor Driving Rolling Mill at Plant of Cleveland Hardware Company.

been a very noticeable increase in production by the mill, due to the constant even speed obtained from the motor.

Possibly the most striking feature of the equipment is its simplicity. The motor was placed close to and connected by gears to the rolls, and this with the transformers and control constitutes all the apparatus necessary.

Current is obtained from the Illuminating Company at 11,000 volts, 60 cycles, three-phase, and is stepped down by means of a three-phase oil-insulated self-cooling transformer to that for which the motor is wound, namely 2200 volts.

The motor is of the Westinghouse wound-rotor type with a rating of 450 horsepower at 900 revolutions per minute and 360 horsepower at 720 revolutions per minute. These synchronous speeds are obtained through a double winding designed to give the motor either eight or ten poles, according to the speed desired.

The synchronous speeds of the motor are reduced to speeds of the mill shaft of 240 and 192 revolutions per minute, respectively, by means of a herringbone type gear drive which operates in oil in a completely inclosed case.

The motor shaft is connected to the pinion by means of a Nuttall spring type flexible coupling especially designed for steel mill service.

A similar coupling connects the gear to a 10-ton, open-hearth steel flywheel, 12 feet in diameter, which is mounted on two extra heavy pillow blocks, the other end being connected to the rolling mill. The wheel is made in one piece with rectangular arms.

The control of the equipment is handled by a two-panel black enamel switchboard mounted on angle frame iron frame work.

The switches for changing the windings on the motor from eight to ten poles are oil immersed, one in the primary and one in the secondary circuit. Proper markings are placed thereon so the mill operator can easily manipulate them. The primary breakers are mechanically interlocked, so but one can be closed at any one time.

In case it is necessary to stop the mill quickly, as in an emergency, the running breaker is tripped which causes all the secondary breakers to open. The operator then closes the reverse breaker which quickly brings the motor to rest.

The operation has been an entire success from its beginning and, in the opinion of the officials of the company, electric drive is the most desirable form of motive power to be considered for rolling mills.

An idea of the work being done by the mill may be gained from the following figures:

In an average 8-hour shift, the average tonnage of three-eighths-inch rounds from 4 by 4-inch billets, 90 to 100 pounds in weight, 0.25 per cent carbon, is 35 tons; 7/8-inch squares, 45 tons; 1¾ by ¼-inch flats, 40 tons; 100 to 135 pounds, 4 by 5/16-inch flat, 35 tons; and 40-pound, 0.15 per cent carbon, ¾ to ⅛-inch flat, 15 tons; 50-pound, ¾ to 3/16-inch flat, 20 tons; 40-pound, ⅜-inch round, 20 tons; 55-pound, ½ by 5/16-inch oval, 30 tons.

The entire electrical equipment was furnished and installed by the Westinghouse Electric & Manufacturing Company. Howard R. Taylor is the mechanical engineer of the Cleveland Hardware Company, and was responsible for the change over from steam to electric drive which has worked out to his entire satisfaction.

Massillon Company Has Record Output on December 31.

The Massillon (O.) Electric & Gas Company closed the year 1917 by making December 31 its record day in output, having a net generation for that date of 104,490 kilowatt-hours; the output for the month of December being 2,786,000 kilowatt-hours. Some idea of the wonderful growth of the Massillon Company can be obtained by realizing that the output for the year ending December 31, 1913, was but 1,898,374 kilowatt-hours. The output for December, 1917 was therefore nearly twice that of the entire year of 1913.

NEW-BUSINESS ACTIVITIES AT DAYTON, OHIO.

Dayton Power & Light Company Secures 2798 New Customers During Past Year.

The Dayton Power & Light Company, Dayton, Ohio, is supplying 87 per cent of the factory power in that city, and this amounts to 75 per cent of all the power used in the city. In spite of war conditions, there was an increase of 16 per cent in the company's Dayton business for 1917. During that period 2798 New customers for light and power were secured.

The increase of power consumption has been especially marked. A number of new plants, equipped for electric drive, for which this company is furnishing power, and others in which electric power has replaced steam, may be noted as follows:

Dayton Oxy-Hydrogen plant has doubled its power equipment by installing 100 horsepower in motors. It takes central-station energy at 6600 volts, alternating current, at its tranformers. Other new equipment consists of a 100-horsepower motor-generator set for changing to direct current for its electolytic cells. All other power used is alternating current.

The Dayton Steel Foundry Company has made a 300-per cent increase in its furnace capacity, now having two Snyder electric furnaces of 500-kilowatt and 1500-kilowatt capacity, respectively; the first is a single-phase and the second a 2-phase furnace for steel refining. For furnace heat and other power about 300,000 kilowatt-hours per month of central-station energy are purchased.

The Dayton Rubber Manufacturing Company lately contracted for energy for 450-horsepower motors in its new factory, in which both alternating and direct current are used. One feature of its equipment is a rotary converter for supplying power to the direct-current motors by which the calenders are operated.

The Dayton Power & Light Company also recently secured a contract for supplying energy to operate the motors of 1000-horsepower in the large cordage and binding-twine factory of Hooven & Allison Company, Xenia, Ohio. About 300 horsepower of this installation will be in operation by January 15.

The Dayton Manufacturing Company, which for many years used power produced in its own plant, now finds it more economical to use central-station service, and has contracted for 175 horsepower. This company makes interior metal fixtures for Pullman cars.

A. E. Simonds & Sons Company, Dayton, makers of paper and beater knives, such as are used in paper mills, is installing individual motors to a number of its grinders. The motors of 150 horsepower being installed will give the factory 450-horsepower, for all of which central-station power will be used. In the new arrangements, all leather-belt transmission will be eliminated, and Link-Belt Company's silent chain drive will be installed instead.

Rike-Kumler Company, having one of the largest department stores in Dayton, is changing over from its isolated electric power plant to central-station service, now requiring 300 kilowatts for lighting, and for motors to drive elevators, ice-making machine and ventilators.

NEW YORK COMMISSION URGES ECONOMY IN USE OF GAS AND ELECTRICITY.

The Public Service Commission, Second District, New York, has issued an appeal to consumers to save coal by a more economical use of gas and electricity. Gas, being produced mostly from coal, and electric power, being generated by coal power at the majority of plants, may both be used more economically by proper attention. In the use of gas lighting, the open flame light should not be used; instead, the mantle burner should always be used, whereby the same illumination is secured with the consumption of 60 per cent less gas. Another means of economy, without restricting the service, is to see that burners are turned off when not actually needed. This should apply to lamps, gas stoves and water heaters. As a means of saving electrical energy it is advised that mazda, instead of carbon, lamps be used, by which the desired lighting service may be obtained with one-third the current consumed by a carbon lamp. The disuse for the present of electric display signs and ornamental illumination are especially advised. All these economies relate back to the consumption of coal, which in the aggregate for the entire country means a tremendous saving of that fuel, so necessary in the winning of this war. Attention is also called to the conservation of coal which may be effected by all possible electric generation by water power.

MOTORS REPLACE STEAM ENGINE IN DAIRY.

Lower Operating Costs and Increased Cleanliness Principal Advantages.

By J. P. Moore.

The Andalusia Dairy Company, located at Salem, Ohio, collects milk from the surrounding territory and

Fig. 1.—Induction Motor Belted to a Ten-Ton Refrigerating Machine. Induction Motor Belted to a 35-Ton Vertical Refrigerating Machine in Background.

distributes it to the larger cities. It receives an average of 800 ten-gallon cans of milk daily and ships about 75,000 pounds of milk, principally to Youngstown and Pittsburgh, each day. It also makes and ships about 1000 gallons of ice cream daily and has an annual output of about 1,500,000 pounds of butter.

The plant was steam-engine driven until the fall of 1916 at which time alternating-current motors were installed. In Fig. 1 are shown the two ice machines, the one in the foreground being a ten-ton machine driven by a 20-horsepower Westinghouse type CW motor. The other is a 35-ton vertical machine driven

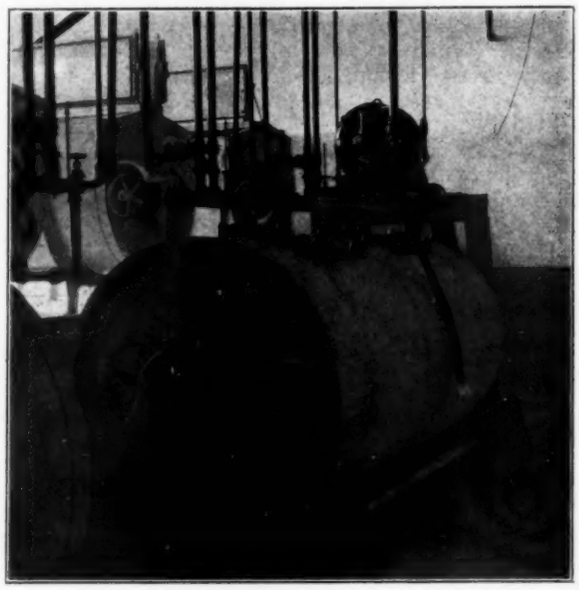


Fig. 2.—Squirrel-Cage Induction Motor Belted to a 300-Gallon Churn.

by a 50-horsepower Westinghouse CW motor. These machines supply refrigeration for the entire plant besides making an average of five tons of ice daily. This is used around the plant, and in packing and shipping ice cream. There is also a 3-horsepower motor driving a Creasy ice breaker, and a 5-horsepower motor direct-connected to the circulating pump on the brine tank.

The two 300-gallon churns are individually driven, each being belted to a 5-horsepower motor. One of these is shown in Fig. 2 in the foreground and in the background are the harmonizers belted to a line shaft and driven by a 10-horsepower motor. There are two pasteurizing machines, each driven by a 3-horsepower motor.

The only steam used in the plant is for sterilizing and cleaning the cans; the machine for this purpose is driven by a one-horsepower motor. All of these motors are of Westinghouse make.

E. H. Campbell, the manager of the plant, says that since the change to electric power, his operating cost has been no more than it was before and the saving in labor, dirt and noise has more than balanced the cost of the new equipment. He is very enthusiastic and heartily recommends this power to all dairymen.

New Committee to Consider Water-power Legislation.

The first step toward carrying out President Wilson's recommendation that all water-power legislation be incorporated in an omnibus measure that may be speedily approved was taken when Chairman Pou of the House rules committee introduced a resolution for the creation of a special joint committee of 18 to consider water-power legislation. The public lands committee and the interstate and foreign commerce committee are discharged under the resolution from consideration of water-power bills.

Operating

Co-ordinating Furnace Requirements—Methods for Increasing Capacity—February Street-Lighting Schedule

CO-ORDINATING FURNACE REQUIREMENTS WITH BOILER PERFORMANCE.

Calibrated Flow Meter Tells Amount of Coal and Air Required for Best Efficiency at All Outputs.

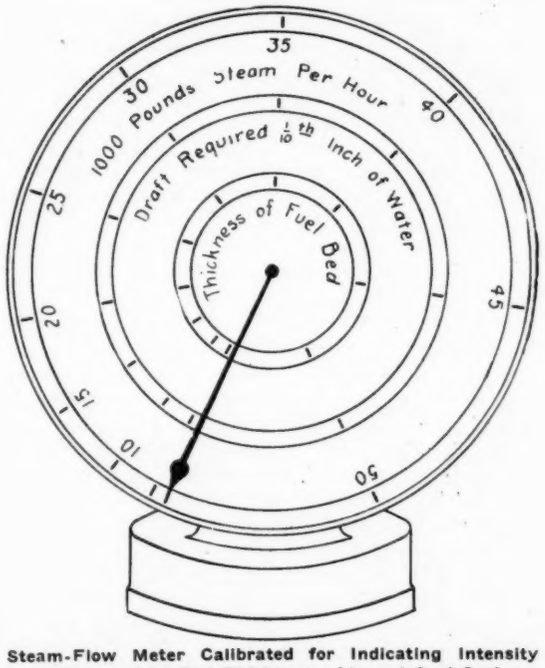
By Lionel Linnell.

In many boiler rooms the only meter or equipment for the firemen's guidance is the steam-pressure gauge and possibly a water column for indicating the draft under and over the fire. That a fireman may be able to maintain uniform results in firing and sustain them it is necessary that he know what he is doing, what he is required to do and how he is doing it. To accomplish these things completely necessitates a CO_2 recorder for indicating combustion efficiency, a steam-flow meter for indicating rate of production of steam, an air gauge or water column for indicating the draft or quantity of air being used and the condition of the fuel bed, in addition to measurements of coal and ash. However, so many instruments are rarely used because of the expense required initially and for maintenance, and also because often the labor is not suitable for their manipulation. Suppose the matter then comes down to which instruments shall be adopted, suppose on the basis of maximum results with a minimum of instruments. The water column should invariably be used because it gives an insight to the fuel bed, heating surfaces and rate of firing, and comparison amongst the individual boilers. Moreover, it is cheap and easily installed and maintained. The weighing of the coal and ash properly belongs to the engineer in charge and not to the fireman, whose work consists of caring for the fires, and perhaps also the water levels in the boiler. He therefore is concerned with the performance of his fires. The CO_2 recorder indicates combustion but not rate of work. On the other hand, the steam-flow meter indicates rate of work but not how efficiently that work is being performed. It would seem that while efficiency is vitally important, it is more important still to know the rate at which you are working, from which efficiency can be obtained later, for how can there be efficiency when you do not know what you are doing?

Calibrating the Meter.

Suppose then that it is decided to use a steam-flow meter and a water column on each boiler. The problem then remains as to how best maintain the highest efficiencies at all times and rates of burning, since there is nothing with these two devices that will tell anything about efficiency. The writer will explain how a steam-flow meter of the indicating type, for example the G. E. flow meter, may be made to indicate the amount of coal and air required for all rates of steam production as indicated by the flow meter, for a definite combustion efficiency, that is percentage of CO_2. The indications given under these conditions are not what is going on in the furnace, which is the case where the CO_2 recorder is used, but what is required for a definite result. It is obvious therefore that a flow meter used in this way is a guide to the fireman, if he lives up to its indications, telling him what to do instead of what he has done.

For a definite rate of steam-making as indicated by a steam-flow meter there is required a definite amount of coal consumed, which means a definite thickness of fuel bed. For a definite thickness of fuel bed, and for a definite percentage of carbon dioxide there is required a definite quantity of air, which may be expressed as draft. The amount of air required for a given thickness of fuel bed, as also the air pressure as



A Steam-Flow Meter Calibrated for Indicating Intensity of Draft and Fuel-Bed Thickness. Air and Coal Scales Calibrated by Test.

indicated by water column depends upon the characteristics of the coal, its composition and size. Now for a given coal there is a certain amount of excess air required for best commercial combustion efficiency, and this can be obtained by test with a CO_2 recorder. The air pressure or draft required to force this air through the fuel bed will depend upon the thickness of the fuel bed and its condition. However, when once determined for a given coal, fired by a given equipment under given conditions for constant percentage of carbon dioxide at all times, it can be seen that air pressure as expressed by the water column bears a direct relation to the percentage of CO_2 as indicated by flue-gas analysis. Now, then, if a test is run on a boiler with a certain coal and the CO_2, the air pressure under the fire or ash-pit pressure, the coal

consumed, and the rate of steam flow are determined at all rates of steam flow at maximum desirable percentage of CO_2, a fireman knows all he needs to know about what he is doing at all loads.

The above determinations require four measuring devices, namely, a CO_2 recorder, a water column, a coal-weighing machine and a steam-flow meter. But it has been shown that the rate of coal consumption, the amount of air required to burn it at definite efficiency and the rate of steam production all have definite values at any value of any one, and all are dependent upon output as measured by the steam-flow meter. It would appear a natural procedure, therefore, to co-ordinate these various factors and indicate them upon the steam-flow meter. In doing so it should be remembered that the draft required will vary with different coals, and therefore periodic checks with a CO_2 recorder should be made in conjunction with keeping close watch upon the uniformity of coal supplied.

Limitations of the Meter.

Emphasis should be made of the fact that the above calibration of an indicating steam-flow meter of the G. E. type indicates the amount of fuel and air required, based upon test, according to definite production of steam. It does not tell to what extent the fireman is doing so, as do the individual meters or instruments of the Bailey type.

The above application of the steam-flow meter is not recommended as a substitute for the CO_2 recorder, for it is invaluable in every boiler room if it is properly manipulated and its results correctly interpreted, because the former shows what ought to be done, whereas the latter shows what is being done. Moreover, the former is correct for a given grade of coal and is not flexible, hence may lead to error unless checked in conjunction with changes of fuel. However, it is better than no meter at all in these days of high coal prices and coal difficult to obtain.

There are numerous companies that have used various types of CO_2 recorders until the recent high price and extreme scarcity of caustic potash has caused them to abandon them for the time being. Firemen who have become accustomed to the CO_2 recorder like it and feel lost without it. The use of the steam-flow meter in the way above described will be much appreciated under these circumstances.

It should be pointed out that at this time coal deliveries vary widely in quality, and frequent calibrations may be necessary unless the combination steam-air-coal instrument is not to cause inefficient furnace operation. It might be well under these circumstances to employ different scales for the flow meter according to the source from which the coal has been received and based upon analysis of samples and test. These scales should be marked and slipped into the flow meter instead of being fastened down as they would be were they permanent for uniform coal supply. For uniform fuel supply it might be advisable to make adjustments seasonally on account of climatic changes, especially for summer and winter months where seasonal changes are radical, since the specific gravity of air is a function of temperature.

The method of adopting a steam-flow meter in the way described has been roughly described in rather loose language. However, it suffices for those that would be in a position to understand and apply the idea properly. The two factors necessary for satisfactory results are that the data first obtained be sufficiently extensive and accurate to typify conditions; secondly, that a check of performance and fuel be made with necessary frequency. Air infiltration has been ignored, although its extent would be brought out by the CO_2 recorder and acted upon accordingly. The rate of coal consumption may be marked upon the flow meter, either as pounds consumed upon the same basis as that indicated by the flow meter or as thickness of fuel bed, according to choice, the later being probably preferable with hand firing.

The above is a compromise method that will help the firemen obtain better results than where they have nothing more than a pressure gauge or a flow meter; it will reduce the difficulties incidental to cessation of using the CO_2 recorder, and assist maintenance of efficiencies, for hand-fired manually controlled plants. It is inferior to the automatically controlled furnaces, of course, and also to the use of CO_2 recorders in connection with water column and flow meter. However, as a war measure, and to assist saving coal as a national obligation as well as a selfish motive, it is better than nothing for guidance of the firemen.

METHODS OF INCREASING CAPACITY OF ELECTRICAL APPARATUS.

Attention to Cooling Media, Cooling Surfaces and Housing May Increase Capacity.

By M. S. Montgomery.

Everywhere it is the same story, heavy sustained loads, shortage of capacity and inability to obtain additional equipment. As additional capacity is unobtainable the only thing to do is to take every feasible and practical step to increase the capacity of what apparatus is on hand. The gain by doing this may not be large, individually, but in the aggregate may often prove worth while. An increase of capacity of one to five per cent and sometimes even more is not to be despised these days.

Condition of Oil Affects Ventilation.

Cooling with oil is accomplished in several ways. The oil transmits the heat to the outer surfaces of the container, from which it is radiated. Heat is carried away by convection, cold oil sinking and hot oil rising. Dirty, thick oil that cannot move readily and oil ducts obstructed so that oil cannot circulate are neither of them conducive for efficient heat transfer from windings to oil and thence to air. Long sustained high operating temperatures, and this is especially true with the older and cheaper oils, cause sludging, which is a thick mass, to form in the oil and on adjacent surfaces. All oils not in the best condition should be renovated and filtered. If time permits, old apparatus long in service should be taken out of their cases and cleaned, deposits removed from the coils as they interfere with heat transfer, and oil ducts cleaned out as far as possible. The oil level should always be watched as a small but continuous leakage of oil through cracks and along leads due to syphoning may after several years appreciably lower oil levels and thus reduce the amount of oil available for heat dissipation. In foundries and steel mills it is not uncommon to see the transformer cases covered to considerable thickness with dust and felt-like material. This coating should be cleaned off as it tends to retard heat dissipation.

With oil-filled water-cooled transformers it is a good practice to lower the oil level, once a year at any rate, and examine the water coils. It is quite common to find them covered with a film of grease somewhat

of the appearance of vaseline. This film is due to deposition from the oil of either impurities in the oil itself or matter abstracted from the coils, some oils acting as solvents for the impregnating compounds used to insulate the windings. As this film is a fairly efficient heat insulator, cooling is interfered with. By removing it water can be saved or capacities increased. The inside of water cooling coils should also be examined for scale, an unusual occurrence where city water is used but not uncommon where well and river water is used. Scale reduces the water flow as also the heat transmission from oil to water.

Oil-filled transformers are usually either filled with oil which is allowed to circulate within the tank according to temperature difference, namely by convection, or else are filled with oil and augmented with water cooling. An increased circulation and hence heat dissipation can be obtained by the circulation of the oil. While the result is always pronounced the difficulties should be borne in mind. It is difficult to circulate oil without loss due to leakage. Moisture may readily be taken up from the circulating pump or piping system; oil is hygroscopic also. There is also the fire risk to be remembered. However, with care the circulation of oil, and its cooling may sometimes prove a very convenient and satisfactory way out of a dilemma.

Utilizing Natural Ventilation.

There is often found in many stations a surprising lack of thought as to the utilization of natural draft or circulation of air. Ambient temperatures play a large part in deciding the maximum capacity that can be safely carried by any piece of apparatus. Reduction of the ambient temperature always enables an increase in capacity. It is not uncommon to find a number of pole type transformers installed within a cramped space, each standing upon the floor, and needlessly close to one another. Units should be spaced so as to permit a free circulation of air around each. Raising the individual units off the floor a matter of three to six inches also tends to improve the heat dissipation.

Perhaps it may be said that it is the rule rather than the exception to find air temperatures of transformer ducts and vaults in commercial substations and customers' installations needlessly and injuriously high. Many of these vaults are not ventilated at all, and the only escape for the heat is through the walls by radiation. In such cases if hard put to it in carrying loads, knock a few holes in the walls just above the floor level, and more just below the ceiling. Protect these holes by screens to prevent insects and animals from getting into the transformer vault; also rain and snow, by requisite baffling. A chimney placed over or better still to one side of the transformers since they are not then endangered by moisture, and so arranged as to create draft will help out many a transformer in need of air. In some cases motor-driven fans are installed in transformer vaults containing oil-filled units. The judicious use of vents and chimneys would enable the same results to have been obtained by natural instead of mechanical draft, which is of course cheaper, requires no maintenance, while there is never the uncertainty as to whether the blower has ceased running.

The Fan Is Often Useful.

Rotating machines heavily loaded should of course be kept as clean as possible, thus assuring the circulation of air through the windings and air ducts. Taking in the air from outside instead of from the hot dirty station may often be a wise and effective measure. Air washers are now used quite generally, as is also the water spray for air cooling. Home-made affairs can frequently be made efficient as well as effective and save much annoyance and expense. Such a departure is, however, a radical one, that may not be feasible nor economically justifiable.

Rotating machines may often have their capacity increased very materially by installing a fan on the shaft, the effect being to increase the air passed through the machine parts. Usually such a fan can be installed very cheaply where the frame or bearings permit. In using a fan it may be found that it is more efficient to use the fan for sucking the air out of the machine rather than driving it in. Experimentation as to the use of a few fan blades on a machine may show very pleasing results, and is well worth trying where equipment is overloaded.

The secret of ventilation, whether oil, water or air are used, is to have plenty of it, apply it effectively and keep up the supply continuously. Clean air, clean water, and clean oil are more efficient than when dirty, and also occasion less trouble.

Street Lighting Schedules for February.

Enforced economy, due to precarious fuel supplies, shortage of public funds, promulgation of "lightless" nights, and other war conditions, is causing many communities to exercise exceptional care in the matter of street lighting. This enhances the importance of reliable schedules of such lighting, especially the standard all-night and the moonlight schedule, the latter being revived in many cities that formerly had abandoned it. The following table gives these two widely used schedules for February. The time is given in mean local solar time and the table is compiled for latitude 40° north.

FEBRUARY, 1918.

Night of Feb.	All-Night Schedule		Moonlight Schedule	
	Light	Extinguish	Light	Extinguish
1	**5:50**	6:40	**5:50**	**11:45**
2	**5:50**	6:40	**5:50**	12:45
3	**5:50**	6:35	**5:50**	1:45
4	**5:50**	6:35	**5:50**	2:45
5	**5:55**	6:35	**5:55**	3:45
6	**5:55**	6:35	**5:55**	4:45
7	**5:55**	6:30	**5:55**	5:35
8	**5:55**	6:30	**5:55**	6:00
9	**6:00**	6:30	**6:00**	6:00
10	**6:00**	6:30	**6:00**	6:00
11	**6:00**	6:30	**6:00**	6:00
12	**6:00**	6:25	**6:00**	5:55
13	**6:05**	6:25	**7:30**	5:55
14	**6:05**	6:25	**8:45**	5:55
15	**6:05**	6:25	**9:55**	5:55
16	**6:05**	6:20	**11:10**	5:50
17	**6:05**	6:20	12:15	5:50
18	**6:10**	6:20	1:15	5:50
19	**6:10**	6:20	2:10	5:50
20	**6:10**	6:15	3:00	5:45
21	**6:10**	6:15	3:35	5:45
22	**6:15**	6:15	4:10	5:45
23	**6:15**	6:10	No light	
24	**6:15**	6:10	No light	
25	**6:15**	6:10	No light	
26	**6:20**	6:10	**6:20**	**7:40**
27	**6:20**	6:05	**6:20**	**8:35**
28	**6:20**	6:05	**6:20**	**9:35**

Tables for the remainder of the year, rules for the two schedules given and for modifications of them, corrections for standard time and latitude, monthly and yearly total hours of burning for five common schedules, as well as other information pertinent to the subject, are printed in a booklet obtainable from the Electrical Review for 25 cents a copy.

Construction

Best Conduit-Bending Practice—Use of Insulating Joints—Armored-Cable Wiring Hint—Doings Among Contractors

METHODS OF BENDING CONDUIT.

Second of a Series of Articles Describing the Best Practice.

By Terrell Croft.

A Right-Angle Bend May Be Made with Two Hickeys, as illustrated in Figs. 6 and 7. This method may be desirable where a number of lengths of conduit must have formed in them turns of uniform contour.

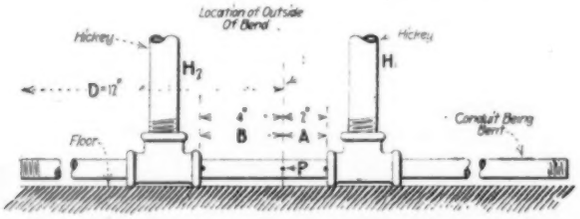


Fig. 6.—First Position in Forming a Bend with Two Hickeys. The Dimensions Shown Are Those for ½-Inch Conduit.

While with obvious variations the general procedure indicated may be followed for bends of almost any degree, the directions which follow relate specifically to 90-degree or right-angle elbows in one-half-inch conduit. Where a bending machine is available, it should be used in preference to the two hickeys.

First, lay off the required dimension (*D* Fig. 6) equal to the distance from the end of the conduit to the outer face of the bend which is to be made. (In the example shown *D* is taken as 12 inches). Make a center punch or chalk mark *P* on the conduit indicating this location. Second, make another mark on

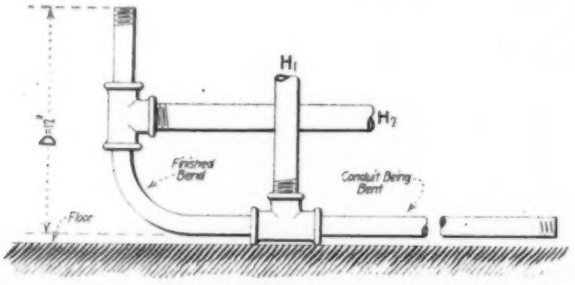


Fig. 7.—Second Position When Forming a Bend with Two Hickeys.

the conduit 2 inches to the right of *P* and place the face of one of the hickeys H_1 at this mark, as diagrammed in Fig. 6. Now make a third mark 4 inches to the left of *P*, and slip the second hickey H_2 along the tube until its face lines up with this mark. Fourth, force the upper ends of the handles of the two hickeys together with the hands. Then, holding H_1 vertically, force H_2 around until it lies at right angles to H_1. The bend will thereby be formed and it will be in the location required. The accompanying Table I gives the distances *A* and *B* (Fig. 6) for one-half-inch, three-quarter-inch and one-inch conduits, which are the only sizes for which the method is ordinarily applicable.

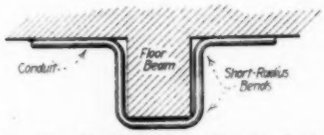


Fig. 8.—Conduit with Short-Radius Bends Installed Around Beam.

Table I—Indicating Locations of Hickeys When Forming a Right-Angle Bend by the Two-Hickey Method.

(The reference letters are those in Fig. 6.)

Size of Conduit.	A Distance from Location Line to Face of Hickey H_1.	B Distance from Location Line to Face of Hickey H_2.
½-inch	2 inches	4 inches
¾-inch	3 inches	5 inches
1-inch	4 inches	6 inches

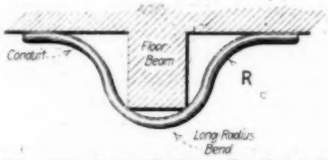


Fig. 9.—Conduit with Long-Radius Bends Installed Around Beam.

To Make a Short-Radius Bend in Conduit for a location such as that indicated in Fig. 8, the method to be described can be used. Where turns of the usual radius are made, the conduits do not lie close to the surfaces and present the undesirable appearance delineated in Fig. 9. But with this method, bends of the approximate form diagrammed in Fig. 8 can be so made that the inner face of the conduit will lie not more than 1¼ inches from the faces of the beam. A sleeve *P*, of a larger diameter than the conduit *C* being

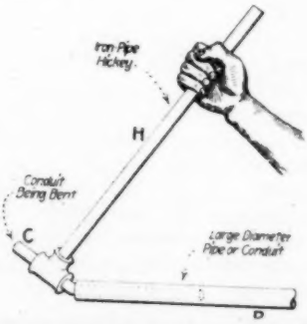


Fig. 10.—Simple Method of Making Short-Radius Bends.

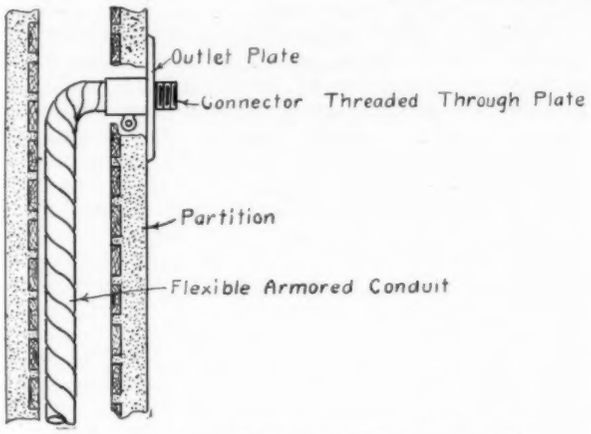
bent, is slipped ove the end of the conduit (Fig. 10) and then the short-radius turn can be formed with a hickey *H*.

(To Be Continued.)

Outlet Plate for Armored-Cable Wiring.

By M. J. Moriarty.

Where armored cable, such as BX, is fished up to a point in a partition, where it is desired to break through and run on the surface, an outlet plate has been found very handy. This outlet plate may be a square or round cover of any of the standard lines of



Outlet Plate Where Cable Passes Through Partition.

conduit boxes, or a bevelled brass plate about 4½ inches square. This plate gives a finished appearance and does not call for plaster of paris patches as the old way usually does. The thread sticking through the plate gives an opportunity for any of the rigid or armored-cable fittings to be screwed on.

To Patch Japan-Finished Surfaces.

By A. Gemmell.

When the black enamel or japan finish on motors, generators, or in fact any electrical apparatus, has chipped off or has been knocked off by rough usage, common black paint is often used to cover up the spots. Such painted patches are scratched easily and soon lose their luster. A much better substitute can be secured by using the following mixture: Asphalt, one pound; lamp black, one-quarter pound; resin, one-half pound; spirits of turpentine, one quart, and enough linseed oil to make the lampblack into a paste before mixing it with the other ingredients. Mix thoroughly and apply with a varnish brush.

Why Insulating Joints Are Used.

By J. C. Arthur.

In conduit wiring systems a fixture is usually insulated from the conduit with an insulating joint, while the wires elsewhere in the conduit system lie against the conduit, which is always grounded. The reasons for this are that the wire used in wiring electric fixtures is not insulated as heavily as that required for the rest of the wiring system, and, furthermore, this wire is drawn through tight places and around sharp corners and is otherwise abused. Due to these conditions, grounds and short-circuits are likely to occur in fixtures. The fixture is the weakest part electrically of a wiring installation. For these reasons it has been considered desirable to maintain the metal work of fixtures insulated from ground, unless the wire that is used for wiring the fixtures has the same insulation as that required in the remainder of the wiring. This is especially true of combination electric and gas fixtures.

It should be noted, however, that there is an agitation for omitting the insulating joint on straight electric fixtures that are wired in a superior manner and have the casings grounded. No change on this matter was made in the revision of the National Electrical Code made last October, but it was generally understood that electrical inspectors could permit omission of the insulating joint on electric fixtures only where their conductors have as good insulation as must be provided throughout all lighting circuits.

Among the Contractors.

Julius C. Draeger has removed his electric shop to 116 North Third Street, Watertown, Wis., where his increased business can be better accommodated by more roomy and better located quarters. Mr. Draeger does a general electrical contracting work and carries a good line of electrical appliances and supplies.

Frank E. Pazdera is the proprietor of "The Electric Shop," a new establishment opened on Harrison Street, Kewaunee, Wis. A large stock of electrical supplies and appliances is carried and all kinds of electrical installation work promptly undertaken. Mr. Pazdera expects to do not only power and light wiring in the city, but to install many 32-volt farm-lighting plants, of which he has a good stock on hand.

The Bison Electrical Company, Inc., 259 Pearl Street, Buffalo, N. Y., is quickly recovering from the fire which recently damaged much of its establishment. Fortunately, the company had a large stock of material and apparatus in its warehouses so that the store has been cleaned up, restocked and reopened for business. The company has taken temporary offices on the second floor of the Builders' Exchange, from which it is directing its extensive contracting business.

The Devere Electric Company, Cincinnati, Ohio, is putting through a contract for the wiring and motor installations in the new factory of the Philip Carey Manufacturing Company in that city, which amounts to about $30,000. The wiring is all in conduit, and the Allis-Chalmers motors being installed will amount to 1000 horsepower. Included in the contract is the installation of a 15-foot six-panel switchboard for power control; also the rewiring of the office building and putting in 50 to 60 four-in-one fixtures for lighting. The new factory machines are being provided with an individual motor for each machine. The job is more than half done. Another contract that Devere company has in hand is conduit wiring of the plant of Samuel C. Tatum Company, Cincinnati, to supply lighting and to operate motors of 100 horsepower; the contract includes motor installations.

The Standard Electric Company is now installed in its new office building at 73 Horton Street, Seattle, Wash., having moved to this location from 316 First Avenue South, where it had been since its organization. Specialties of the firm are marine installations, power work and industrial lighting. Some of the important jobs recently completed were: Complete electrical installations for the Sandstrom shipyards at Ballard and the yard of the MacAteer Shipbuilding Company; installation of a 2.5-ton electric furnace for the Rother Process Steel Company; electrical equipment in the plant of the National Engineering & Equipment Company. The company is now installing a 3-ton electric furnace for the Olympic Steel Works of Seattle.

QUESTIONS AND ANSWERS

All readers are invited to submit questions and answers to this department. Anonymous communications will not be considered. Questions should relate to electrical matters of any kind. Answers contributed by readers should be submitted preferably within eight days of the date of publication of the question and should be limited, if possible, to 300 words. Payment will be made for all answers published.

Questions.

No. 412.—Submarine Radio Signals.—A dispute has arisen between two of my friends respecting the ability of a submarine to receive wireless messages when it is submerged; one man says it can and the other that it cannot receive messages under this condition. The matter has been referred to me and I would like authoritative statements to back up my decision.—H. S. C., Memphis, Tenn.

No. 413.—Electric Room-Heat Regulator.—How does the system of electric thermostatic regulators for controlling the steam heat in rooms operate? I refer to such as are installed in some modern hotels. Is the control circuit of low voltage or 110 volts? How does the system compare with pneumatic regulator systems?—T. J. B., Duluth, Minn.

No. 415.—Demagnetizing Coil.—I would like as complete information as possible about making a coil for demagnetizing by alternating current, especially the size of wire, the best shape of coil, how many turns to use, and how strong a current is required.—M. H. G., New York, N. Y.

No. 417.—Rewinding Induction Motor.—In rewinding a 50-horsepower, three-phase, 220-volt, squirrel-cage motor, will it make any change in the operation or efficiency to use two No. 13 double-cotton-covered wires in parallel in place of one No. 10 double-cotton-covered wire with which the motor is now wound?—H. L. M., Milwaukee, Wis.

Answers.

No. 414.—Static Electricity from Rugs.—I am connected with the mechanical and electrical plant of a large farm company, with many greenhouses, farm and dairy buildings. In the finely equipped home of the owner I have noticed a very peculiar effect recently that I do not understand. In this residence there are some very fine imported rugs that are quite soft and thick. On walking across the room and touching anything of metal, one receives a sharp shock much like the static from a belt in the power house. What is the cause of it?—R. L. G., Reynolda, N. C.

This phenomenon is due to frictional electricity, commonly called "static," and is caused in much the same way as the similar effect noticed on the power-house belts. It is well known that friction of dissimilar materials causes both heat and electricity to be developed. The latter is seldom noticed on damp or warm days, but is more and more marked as the air becomes drier, being therefore especially evident in the coldest winter months, when the humidity indoors is very low. Friction of the shoes on the rugs causes static electric charges of opposite polarity to be formed on the rugs and on the shoes; the latter charge either directly or by induction extends itself to the surface of the body, which is a fair conductor of electricity. On touching anything, whether metallic or not, part of the charge on the body is imparted to the object, thus causing a tiny spark to pass and give the sensation of a shock. If a grounded metallic object is touched, such as a water or gas pipe or steam radiator, a more decided effect is produced because the charges are thereby neutralized through ground. This static effect is especially noticed when rubbing soft and long-fibered fur, wool or other fabrics, which produce more friction and therefore more of this frictional electricity than when rubbing hard substances together.

Frictional electricity was noticed by the ancients when rubbing amber. Although but little was known of it, it was the only form of artificially produced electricity recognized until the studies of Volta and Galvani in the eighteenth and Faraday in the nineteenth century. Nowadays it is only of very minor importance, but often proves troublesome. The friction from carpets from walking across them, especially when shuffling the feet in doing so, has been known for a great many years.

Moisture causes static charges to be quickly dissipated. Therefore by providing some means of increasing the humidity of the air of the room, the trouble, if it really is annoying, can be minimized or entirely overcome. Higher humidity than usually prevails indoors in winter will also make a more healthful atmosphere. As a rule, however, these manifestations of static from walking on carpets are entirely harmless. It should be noted that they have no connection with the electric light or power system of the premises and R. L. G. should assure the occupants of the residence clearly on this point. If he will consult any elementary book on static electricity he may be better able to explain the phenomenon to the household and perform for their benefit some simple and yet interesting experiments that will convince them of the harmless nature of the manifestation.—J. B., Oak Park, Ill.

No. 416.—Watering Coal.—Moisture is admitted as being very objectionable because it lowers the heat value of coal. Why is it, therefore, that so many boiler rooms make it a practice to wet their coal before placing it upon the grate?—A. S. C., Minneapolis, Minn.

Coal is watered before placing it upon the grate because it is often found that the coal burns better from doing so. There are two effects from wetting coal, one is chemical, the other mechanical. The chemical effect plays no part in the benefits of wetting, in fact so far as the combustion of the coal is concerned, the practice is objectionable as the water must be re-evaporated, which requires heat and thus reduces furnace temperatures and coal efficiency. On heating, the water is decomposed into its constituent parts, oxygen and hydrogen, which may in part escape unused up the stack and partly may also assist combustion. In any case, the heat put in for evaporating the moisture out of the coal is greater than that which may be recovered due to recombining of the oxygen and hydrogen.

Probably the sole reason for wetting coal is for mechanical reasons. When coal is wet the individual particles tend to adhere together more than when coal is dry. Coal when wet is therefore more easily handled, with less loss due to spillage and less dirt. Moreover, with the smaller sizes of coal especially, if the coal is wet less of it falls through the grate bars to be lost with the ash. A fire made with wetted coal also seems to hold together better with less tendency to thin spots to occur and holes to burn in the fuel bed, with all the advantages therefrom in the way of lesser excess air and higher combustion efficiency. Another thing, with clinkering coals many firemen claim that if the coal is wetted the clinker that occurs (clinker is fused ash) is less objectionable and more easily handled. With intense drafts, coal that has been wetted is also less likely to blow up the stack in the form of cinder and unburned particles.

Wetting coal lowers the heat value of the coal, compared with the same coal dry, although the mechanical benefits may make up for this deficiency. —L. L., Cleveland, O.

BOOK REVIEWS

"The Lighting Art: Its Practices and Possibilities." By M. Luckiesh. New York: McGraw-Hill Book Company. 224 pages, with 43 illustrations and 9 tables, page size 6x9. Supplied by the Electrical Review Publishing Company, Inc., for $2.50.

Of the many and admirable volumes relating to illumination which have appeared during the past dozen years, it may be that too many have been addressed to the engineer and the scientist. For, while the latter have needed such carefully compiled works, these books have been in large measure beyond the grasp of the laymen and the architect, or, in other words, of the very men who must be roused to a keener appreciation of the practice and possibilities of good lighting if the engineer is to do his part towards the effective installing of the same. Fortunately, the National Lamp Works of the General Electric Company have appreciated the need of educational work along this general line, and the volumes written by the physicist of the Nela Research Laboratory have come to form a welcome annual contribution to the literature which had been needed in paving the way for the services of the illuminating engineer.

In the third of these annual volumes, Mr. Luckiesh quite properly deplores the fact that lighting is today practiced too largely from purely an engineering standpoint, and with too little regard for esthetic, psychological and other aspects of equal importance. Writing in his usual style, equally noted for its accuracy and its readability, the author covers a wide range of aspects and applications of lighting, giving a fund of hints for architects, manufacturers, stage managers and storekeepers and others who ought to be posted on the possibilities of artistic as well as efficient lighting. As was to be expected from Mr. Luckiesh, considerable space is devoted to color in its relation to lighting and two of the most timely chapters relate to applications of artificial daylight and of colored light. The lighting of residences, commercial buildings, public buildings, factories and stages, each call for separate chapters replete with information reflecting some of the most modern practice, and make the volume one which deserves a wide circulation.

Judged by itself, this book might have been made still more valuable if it did not assume so much familiarity on the part of the reader with the contents of other volumes. For example, the inclusion of cuts of typical indirect and semi-indirect lighting fixtures might make parts of the chapters on the "Distribution of Light" still clearer to the lay readers. So also, a few illustrations borrowed from one of the same author's other volumes to show the effect of the direction of light and the application of shade, would make the present work more complete in itself. If the absence of such illustrations is because each of Mr. Luckiesh's annual book offerings is to whet the reader's appetite for more, he has accomplished this already with the closing chapter on "The Language of Color," which suggests some of the interesting possibilities of this year's proposed addition to his highly stimulating series. However, in view of the wealth of pertinent illustrations which have already appeared in technical journals and trade catalogs, such as rarely reach a large share of the desirable readers of such books, an extensive borrowing of cuts from the same would seem highly desirable.

"Practical Wireless Telegraphy." By Elmer E. Bucher. New York: Wireless Press, Inc. Cloth, 330 pages (6x9 inches), 327 illustrations. Supplied by Electrical Review Publishing Company, Inc., for $1.50.

In ordinary times, the reader of this volume might be prejudiced by the discrepancy between the subtitle ("A complete textbook for students of radio communication") and the repeated statement in the preface that no attempt had been made to treat the subject with scientific accuracy or completeness. However, a glance through the book soon shows this to be intended as a practical guide for those wishing to become wireless workers, few of whom would be interested in the refinements of the more accurate theories and explanations. Moreover, with the present demand for wireless operators both on shore and at sea, there should be a real field for a volume squarely aiming to impart such information as might be most needed for understanding the wireless telegraph apparatus now most generally used. For the same reason, the preponderance of space devoted to the Marconi apparatus would seem justified as a proper step towards war-time efficiency, though it would unbalance the book for normal times.

The first 80 pages are devoted to a study of the elements of electricity and magnetism, as the author's experience has shown this to be required as a basis for understanding the methods and apparatus of wireless telegraphy, and this section includes effectively illustrated chapters on motor-generators (with starters for the same) and on storage batteries and charging circuits. With this as a foundation the author proceeds to discussing electrical oscillations and their radiation, and to explaining radio transmitters. Then aerials and antennas, receiving apparatus, emergency apparatus, practical radio measurements, and Marconi transmitters are separately treated. For the casual reader, the chapter on direction finders or wireless compasses may be doubly interesting at this time, while those interested in other makes of apparatus will find chapters devoted to transmitters and receivers for undamped oscillations. So, also, a chapter is devoted to Marconi transoceanic radiotelegraphy. The volume concludes with a series of test questions for prospective wireless operators.

Some of the mathematics introduced in the chapter on practical radio measurements may be beyond the grasp of most wireless students, but will be welcomed by men of college training. Moreover, the very numerous diagrams and cuts are mostly unusually clear and alone should be worth the price of the book.

ALBERT SCHEIBLE.

Production and Consumption of Electric Power at Milan, Italy.

Milan, Italy, whose industries and utilities consume in electrical energy an average of 800,000 kilowatt-hours per day, is supplied with power principally by hydroelectric plants in the Alps, owned and operated by Societa Generale Italiana Edison di Elettricita, and the Azienda Elettrica Municipale. The former is a private company, the latter being municipally owned, and both are controlled in Milan. The first named is equipped with alternating-current turbo-generators of 25,000 kilowatts capacity; the second, similarly equipped, has a capacity of 20,000 kilowatts. Both concerns have auxiliary plants in Milan for use only in seasons of low water in the Alps, or during periods of repairs of hydroelectric plants.

The concerns supplying power do not sell motors to consumers of power.

New Appliances

New Tap Devices—Farm Lighting Plants—Alarm Controller—Cooking Devices—Expansion Joints—Disconnects

Hubbell Double-Outlet Current Tap.

The use of electrical appliances in the home, office and store is becoming so general that the demand for convenient means for attaching the cords of these devices to handy sockets or receptacles is rapidly increasing. Since the number of outlets usually installed in a room is so limited, the solution evidently lies in duplex wall receptacles and current taps. A current tap of this type is now available. It is made

Hubbell Current Tap With Two Side Outlets.

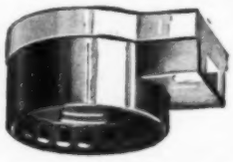
entirely of porcelain and has a shade-holder groove. It corresponds closely to the standard Hubbell single-outlet current tap but has a plug outlet on each side in addition to the lamp outlet below. The side outlets are provided with slots designed to accommodate any of the different Hubbell styles of interchangeable plug caps. This device is manufactured by Harry Hubbell, Inc., Bridgeport, Conn.

Canopy Tap Device.

The Bryant Electric Company, Bridgeport, Conn., has added to its "New Wrinkle" line of wiring devices a novel canopy tap of wide application which can be readily attached to any ceiling or side-wall fixture where a current tap is desired.

The new tap receives any "New Wrinkle" body and many useful combinations can be made. For instance, by wiring across the line and using in conjunction with a New Wrinkle keyless, keyed or pull-chain socket, an additional outlet is provided for an Edison plug flexible-cord attachment to a fan, portable lamp or other device, or any additional Spartan outlet can be provided by using the canopy tap and a Spartan No. 29 plug receptacle.

By connecting the tap in series with the fixture and combining with a New Wrinkle key or pull switch for



"New Wrinkle" Canopy Tap.

wall fixtures or a New Wrinkle pull ceiling switch for ceiling fixtures, convenient means is provided for controlling single or group-lamp fixtures, at the fixture without expensive wiring. The latter use is especially valuable when indirect fixtures are placed in rooms having no flush switches.

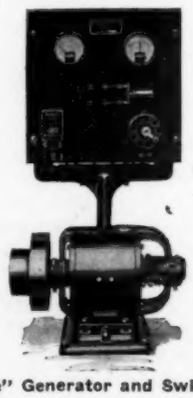
The new device, which is known as the "BZ New Wrinkle canopy tap," is National Electrical Code standard and consists of a New Wrinkle ring and a porcelain base which are easily and firmly attached to the outlet box by means of a stamped steel ring, rings being made for the 3¼-inch and 4-inch boxes.

Canopy Tap with Pull Switch.

In lath-and-plaster construction, the rings are omitted and the base attached by wood screws. After notching the canopy to fit over the neck of the tap it can then be replaced flush with the ceiling or wall, resulting in a neat and unobtrusive job.

New Farm-Lighting Plant.

The Ruralite lighting unit, manufactured by The Gray Electric Company, Springfield, Ohio, illustrated herewith, is especially adapted to illuminating farm



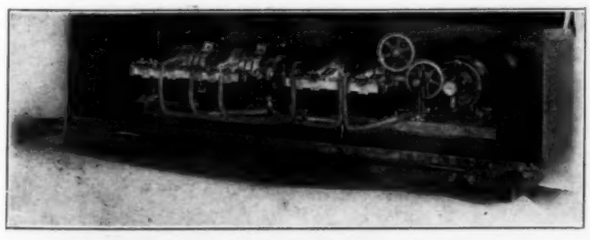
"Ruralite" Generator and Switchboard.

dwellings and farm premises at a cost well within the range of moderate incomes. It consists of a switchboard-generator unit built for capacities of ½ kilowatt to 2 kilowatts, designed for belt connection to a gasoline or oil engine. The switchboard is equipped with 2½, 4½ or 6½-inch diameter instruments, as may be required, with lighting and automatic circuit-breaker. All internal connections between the generator and switchboard are factory made with the special care that prevents trouble due to improper connections. The unit is so arranged that lighting or power may operate either direct from the generator or direct from the storage battery, and the change of connections of lighting service from dynamo to batteries or vice versa may be readily made. Another feature of the Ruralite unit is that the dynamo will automatically supply current for a varied number of lights that may be in operation and at the same time allow the storage batteries to receive their normal charging rate. That is, direct current for lighting is not interrupted while the batteries are being charged. A phase of its design is an automatic electric governing winding whereby the amount of current flowing into the batteries is not affected by the variation in lighting load. In ordinary systems, as the lighting load increases there is a decrease in the current passing into the batteries; and when the lighting load reaches about the normal capacity of the dynamo the batteries receive no current, and if the light consumption amounts to an overload the result is a discharging of the batteries. But, in accordance with tests made with the Ruralite unit, it is shown that while a variation of current from two to 24 amperes are being supplied for lights there is a constant current of 15 amperes passing into the batteries, and this is accomplished without adjusting the voltage regulator.

A gasoline engine of 2, 2½ to 4 horsepower is commonly used for driving a generator of sufficient capacity to supply energy for lighting, battery charging, for pumping water, operating churns, washing machines and vacuum cleaners. This company furnishes Ruralite storage batteries of either the pasted or Planté types, assembled in either rubber or glass jars.

Automatic Controller or Rotary Switch.

There are many places where an automatic controller may be applied. The accompanying cut shows a special controller constructed by the Reynolds Electric Company, of Chicago and New York, for a fire-alarm siren, made by the Federal Sign System (Electric) of Chicago. By an ingenious arrangement of contacts, the sounds from the siren are graduated in tones ranging from low to shrill, and, by means of suitable gearing, the blowing after continuing for a period of two minutes is automatically cut off. To start the controller, the mere pressing of a push-button switch closes the motor circuit and starts the motor driving the controller; another switch on the controller, as stated before, opens the motor circuit after two minutes' operation, thus making practically an automatic device.

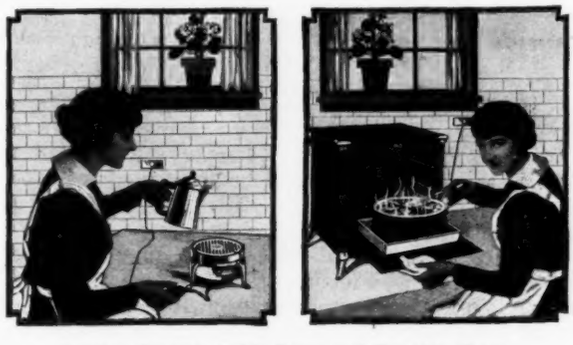


Reynolds Controller for Fire-Alarm Siren.

The motor is direct-geared to the controller to insure a positive drive; the fingers are reinforced at the contact end and are of the "quick break" type and a holder provides for 1-inch take-up in case of wear. The contacts are removable and adjustable. The entire machine including motor is rugged and built for hard service. Similar controllers are now being furnished by the Reynolds Electric Company to the city of Chicago for flashing "STOP" signals, gate lights, and ringing gongs when drawbridge is open and gates are down, giving a positive alarm both by light and sound.

Hughes Electric Ranges, Table Stoves and Portable Ovens.

The electric range, electric table stove, portable oven, and other electric cooking utensils are fully recognized wherever electricity is available for cooking. The Hughes electric range, which is made in twenty sizes and styles, frees the kitchen from smoke, noxious gases, ashes and dirt incident to the burning of coal, wood or gas; and it has been demonstrated that the shrinkage of meats is 20 per cent less when cooked in the electric oven than when cooked in ovens heated by other means. In these times that kind of conservation of meat is certainly worth while. The new Hughes table stove is ideal for the small family and is suitable for preparing a breakfast of bacon and eggs, pan cakes, toast and coffee. The portable oven, in which the roast for dinner may be prepared, along with other dishes, renders this service quickly, economically and without imparting any of the smoke and fumes of the ancient kitchen. This oven has one 660-watt heating element, controlled by a three-heat switch and is built on the fireless-cooker principle with heavy insulated walls. After the cooking process is well under way, the current may be turned off, leaving the cooking to be completed by the accumulated heat of the oven.



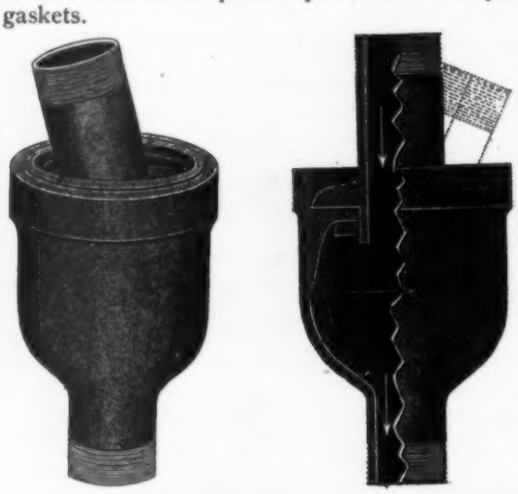
Hughes Electric Table Stove and Portable Oven.

The Hughes ranges, stoves and other cooking appliances are manufactured and sold through dealers by the Edison Electric Appliance Company, 5660 West Taylor Street, Chicago.

Berry Flexible and Expansion Joints.

In these days of enforced fuel and labor economy the maintenance of tight joints in power-plant steam mains is of the utmost importance, as escaping steam represents useless waste of money. There are, how-

ever, many conditions which render the maintaining of joints in a tight condition difficult, owing to excessive vibration, improper provision for expansion and contraction, etc. The waste from leaking joints must not alone be taken into consideration, but also the cost in labor and time of frequent repairs and the replacing of gaskets.



Perspective and Partial Section of the Berry Patented Combined Flexible and Expansion Joint.

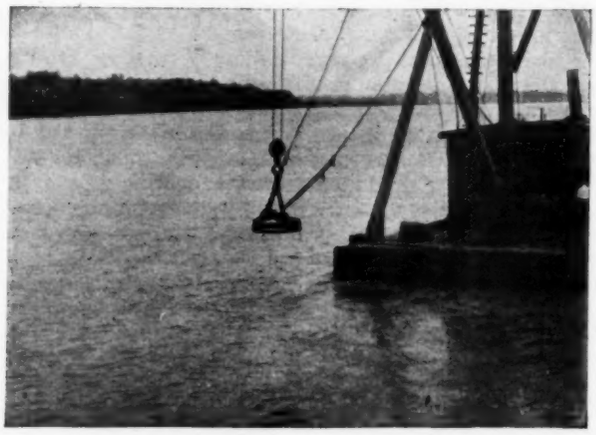
In order to obviate many of the difficulties encountered in the installation and maintenance of pipe lines, the Iron-Clad Joint Company, 400 Godchaux Building, New Orleans, La., has developed and placed on the market the Berry flexible joint shown in the cuts for steam, air or water pipe lines.

The construction of this joint is simple and comprises but few well made parts. One member consists of an expansion chamber, into which is placed the joint nipple or second member. It is locked by a specially designed ring, engaging a projecting shoulder on the joint nipple, the bearing being on the outer edge of the shoulder, thus permitting this second member to take any position desired and allowing free play under vibration. The joint is made tight by a compound fabric cup (this to resist action of steam) securely held by an inner ring and fitting closely in the expansion chamber, its flexibility enabling it to fill in any position, while the back pressure of the steam, air or water makes the joint absolutely leakproof, so that the higher the pressure, the tighter it holds. This form of construction also permits a lengthwise movement, providing the expansion and contraction feature.

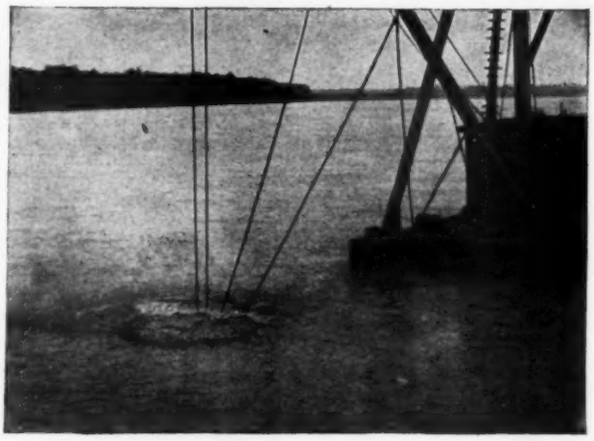
This combined flexible and expansion joint has every action that can be found in any combination of joints. It is said to be the only metal flexible joint invented that has a ball-joint action without actually being a ball joint, and is therefore capable of taking care of vibration while allowing for expansion and contraction. Its flexibility is such that it can swing automatically in any direction, always leaving a full and unobstructed area to the flow. Because of these several and distinct actions, requiring no special attention, and its absolute leakproof feature under any pressure, position and condition, this joint is especially adapted for steam lines where flexibility is essential.

Lifting Magnet Helps Recover Sunken Iron Treasure.

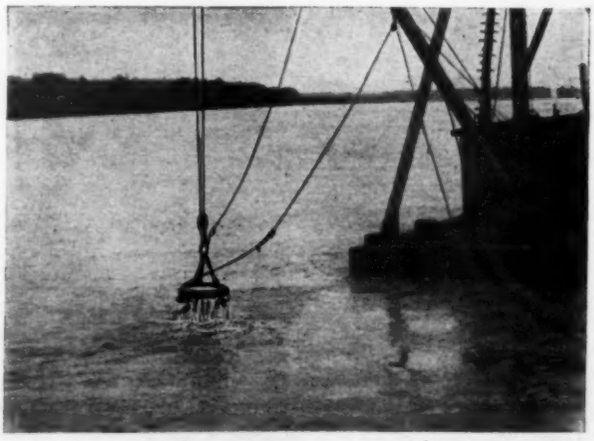
The Arrow Transportation Company, operating a line of barges on several of the southern rivers, lost one of its barges in the Tennessee River near Paducah, Ky., last March. This barge, loaded with about 420 tons of sand-cast pig iron, collided with the pier in the river and the barge began listing, dropping its load gradually and therefore strewing the pig iron along the bed of the river for a distance of about 100 feet or more. The loss represented about $10,000 and the insurance company paid over this amount to the transportation company. The insurance company later made arrangements to recover what it could of the cargo by means of a barge and a lifting magnet purchased from the Cutler-Hammer Manufacturing Com-



C-H Lifting Magnet Being Lowered into River.



Lifting Magnet Submerged and Then Dragged Along River Bed to Pick Up Lost Pig Iron.



Hauling Up the Lifting Magnet with its Load.

pany, Milwaukee, Wis. By letting the magnet down to the bed and dragging it along in the vicinity in which the material had sunk, over 90 per cent, or approximately 400 of the 420 tons, were recovered.

The cargo was not only saved, but because of the rising cost of pig iron it was sold for $16,000, while the total cost of recovering, including the rental of barges and the purchase of a magnet, amounted only to $4,000, which gave the insurance company approximately $2,000 profit plus a lifting magnet, which has since been put to use in salvaging other lost cargoes. The magnet used was 43 inches in diameter, and of the standard C-H type, which is waterproof.

Sub-Cell Disconnecting Switch.

General use of upward-break oil circuit-breakers, with each break in a separate tank, for large central stations, makes it necessary to have a satisfactory and safe disconnecting device for placing in sub-compartments below these oil circuit-breakers. The Electrical Engineers Equipment Company, Chicago, Ill., has developed a switch for this purpose which is claimed to have the following advantages:

The hinge and front clips and clip blocks are made of high-conductivity solid cast copper, without riveted or sweated joints.

The front clip block and stud are made as one solid casting of pure copper.

The front clip block and stud register in grooves in the porcelain, insuring their keeping in absolute alinement.

The lower bushing is cemented into a brass sleeve for a three-bolt support, which permits of accurate lining up and gives a very long and rigid bearing for the lower stud.

The hinge-clip block threads and clamps by means of bolts to the oil circuit-breaker stud, insuring good contact which cannot be affected by expansion and contraction due to temperature change.

Switch blades are of patented construction made up of two laminations to each blade, these laminations being placed outside of the solid contact clips, and held against the clips at both the hinge and front clips by means of bolts and spring washers, giving the same contact pressure on the front clips as on the hinge clips.

The switch is provided with a patented locking device, which locks the switch open and closed. It also locks the operating hook to the switch blade while it is being opened and closed, and the operating hook cannot be removed until the switch is locked either open or closed. This is as near a complete safety and foolproof device as can be provided for switches of this type.

The blade laminations are sufficiently thin to permit the blades to line up accurately for making full contact, a point which is important owing to the fact that the studs or the switch pass through separate bases, making it more difficult to obtain the proper alinement than for conditions in which both studs are mounted on the same base.

The use of two blade laminations for each clip outside of solid contact clips, instead of the usual arrangement of one blade between thin clips, gives a greatly increased radiating surface and consequently less temperature rise, with otherwise the same factors of contact area, cross section, etc.

Switches as described above are of 800-ampere capacity, and use multiple blades consisting of two laminations per blade.

New Sub-Compartment Disconnecting Switch.

The detail construction is simple and rugged, giving the switch easy operation but positive and reliable action.

Experience of this manufacturer has been that this design of disconnecting switch, which eliminates the use of thin clips riveted and sweated into the blocks, and which depends on the spring in these clips for making contact on the front clip, is meeting with general favor by central-station engineers as a device which will insure satisfactory contact, ease of adjustment, and permanent satisfaction.

Electricity Aids Red Cross Work.

Kohler Brothers, 111 North Jefferson Street, Chicago, Ill., are among the electrical firms who are doing their share in promoting Red Cross work. A recent invention by them, which has not been marketed as yet, but is reported to be a great success, is an electric roller for use in making the much-needed five-yard rolls or bandages. This new device is not only a great time and labor saver, but requires little practice to learn to operate. The rollers operated by hand, as they have been heretofore, require skill and training to operate them successfully, and the work is strenuous. By rolling electrically the operator is able to keep both hands on the bandage, while in hand operation one hand guides the roll or bandage and the other operates the roller. The Chicago Woman's Club Auxiliary, which is doing much Red Cross work, and which was the first auxiliary in Chicago to install its own electric bandage-cutting machine, has again taken the lead by installing this electric roller, which is meeting with so much success.

Trade Activities

Valuable Catalogs Distributed—Larger Quarters Being Opened—Machinery and Equipment Recently Installed

Wirt Company, Philadelphia, Pa., has issued convenient folders dealing with its Dim-A-Lite device. They point out the special rooms where this dimming arrangement is especially suitable. The result of tests made by the Bureau of Standards, Washington, D. C., are given of this device, showing its decided economy. The leaflet also shows the two common forms of the ordinary Dim-A-Lite and also several types of the Dim-A-Lite socket.

Trumbull Electric Manufacturing Company, Plainville, Conn., is distributing a new bulletin covering its line of safety service knife switches. These switches embody two special features, the first being that the box cannot be opened until the switch is disconnected and the second that when opened the switch cannot again be connected until the cover of the box is closed. The new line of switches is complete and covers all general requirements for switches of this type. The bulletin also describes a line of enclosed switches that are not externally operated.

Main Electric Manufacturing Company, 500-520 Aiken Avenue and Pennsylvania Railroad, Pittsburgh, Pa., has issued and is distributing its new catalog No. 100, superseding all previous issues. In this 40-page catalog the Main electric light plants, adapted especially for farm service, are fully described and well illustrated. The Main plant is furnished in capacity not only for lighting farm buildings and premises, but for power required in operating the washing machine, cream separator, pumps and feed chopper. The plant consists of gasoline, kerosene or gas engine, belt connected to a dynamo, with switchboard and storage battery. These plants are made in sizes from 10 lights up to 50, 75, 100 and 150 lights. A plant of larger unit, designed for power and light in hotels, hospitals, clubs and factories, consists of a Main direct-connected set, built in two sizes, with 6-kilowatt and 12½-kilowatt generators.

The Lindsley Brothers Company, with offices in Chicago, Minneapolis and Spokane, has issued a looseleaf folder dealing with cedar poles in a very complete way. This folder is divided into six sections, each thumb indexed. The first section, entitled "Why," gives testimonials from a number of prominent users of Lindsley Brothers Company's poles. The second section on "Strength Data" contains a large amount of data on the strength of various grades of cedar poles, results of tests and a description of methods by which anyone may determine the size and kind of pole required for any definite purpose and employing different kinds of construction. "Life Data," comprising the third section, deals with the important subject of useful life of cedar poles, based upon the experience of a number of prominent users. There is also included a paper entitled "Poles and Pole Line Construction" that was recently read by G. L. Lindsley before the Indiana Electric Light Association. In the fourth section of the folder under "Treating Data" will be found a treatise on pole treatment by various methods, with costs and the results to be expected. Authentic data as to life and cost is also given, with specifications for treatment with carbolineum and creosote. A table of seasoning, or seasoning calendar, is included, also an amortization table extending to 30 years, and the cost charged for treating poles for various lengths. "Weights and Dimensions" is next dealt with, in which are given all necessary data as to loading of railroad cars, weights, numbers, etc., for carload lots. The last section of the folder deals with "Cross-Arm Data," and gives useful information as to the strains to which cross-arms may be subjected. The results of tests and the methods of determining the breaking strength of cross-arms as employed by the U. S. Government and the City of Portland are given. The folder brings together a large amount of information otherwise difficult to find, with valuable advice from users of experience, and should thus prove of considerable use to operating and designing engineers and electrical engineers in general.

Hess & Son, manufacturers of paste solder, Philadelphia, announce their removal to larger quarters at 1302-4 Filbert Street. They make Tinol paste and wire solders, alcohol torches, flux and other soldering material. Tinol flux paste is non-corrosive, and as it evaporates it leaves a thin coating of clean, bright tin to which the solder readily attaches. The firm issues a folder giving information desired.

The Thomas Wrigley Company (Inc.), of which Thomas Wrigley is president and treasurer, and E. H. Ahlander, secretary, engineers and machinists, and manufacturing special machinery, including repairing, is now located at 504 South Sherman Street, Chicago. This move was made necessary owing to increased business, and the new plant is larger, modern and equipped to handle the company's growing business.

Driver-Harris Company, Harrison, N. J., announces the distribution, January 1, of paid-up life insurance to all employees who have been in the company's service at least six months. Each employee received a policy of $500, and the intention of the company is to make further distribution of such policies to other employees as they reach the six months' service period. The extra wage distribution, based upon salaries earned and terms of service, and payable twice a year, has been increased by 1 per cent this year. The percentage is computed on a graduated scale, increasing with the years of service. The January distribution amounted to $15,000. The fourth annual dinner of the company was given December 28, which was participated in by 146 persons, comprising office staff, heads of factory departments and veteran employees.

H. B. Underwood & Company, 1015-1025 Hamilton Street, Philadelphia, Pa., manufacturers of portable tools for railway repair and machine shops, are sending out an attractive and well illustrated catalog on their products. The firm has been at its present location since 1870. Regarding steam engine repair work, etc., the firm says: "When you require large steam hammer or power plant engine cylinders rebored, valves faced, crank shaft journals and crank pins turned in position, or anything requiring quick work, for larger portable tools than you have at hand, bear in mind that we are equipped for instant service with a complement of tools for almost everything in this line, and have competent mechanics to handle them. Our tools for such work are packed in suitable boxes ready for immediate shipment. We do cylinder boring, etc., in nearly every state in the Union." They also design and build almost anything in the line of special tools.

Ross Power Equipment Company, Indianapolis, Ind., dealer in power machinery, including electrical, steam, gas and oil equipment, both new and second-hand, has a heavy stock on hand, and can make prompt deliveries. O. C. Ross, president and general manager of this company, formerly was with the Allis-Chalmers Company, and has a wide acquaintance among manufacturers, dealers and users of power machinery. Among important sales recently made are the following: To Blair Milling Company, Atchison, Kans., two 750-kilowatt steam turbine units, with condensers and auxiliaries; Rex Manufacturing Company, Connersville, Ind., complete boiler plant and accessories; National Potash Company, Alliance, Neb., steam turbine equipment; Kesler Electric Company, 250-volt engine-generator set; Merchants Heat & Light Company, Indianapolis, motor equipment; Kelby Car & Foundry Company, a 400-kilowatt, engine-type generating unit; Mousanto Chemical Company, St. Louis, a 400-kilowatt alternating-current generating unit; Indiana Power & Water Company, Chicago, two 500-kilowatt steam-turbine generator units, with condensers, exciters, switchboard and auxiliaries; Anderson File Company, and Computing Cheese Cutter Company, boiler equipment; and similar equipment to Lexington Mill & Elevator Company, and U. S. Corrugated Box Company.

Men in Service

Oscar T. Crosby Elected President Inter-Allied War Council—Harry G. Smith Promoted—Sterling Electric's Flag

OSCAR T. CROSBY, the noted electrical engineer, who last spring was appointed assistant secretary of the United States Treasury, has been elected president of the Inter-Allied War Council, recently formed in London, England. This body is to take up questions and problems of war purchases and finances. The sittings of the Council will take place alternately in London and in Paris, those in London to be held in the St. James Palace. Future conferences will be favored by the attendance of the Finance Ministers of France, Great Britain and Italy. In giving an outline of its mission the Council stated that this was the first permanent Inter-Ally body in which the United States was represented, and was the result of efforts initiated by Secretary McAdoo. It has for its primary object consideration of the needs of the Allied Governments for purchases in the United States and purchases in neutral countries will also receive consideration. A co-ordinated study of needs will be made, and when conclusions are reached the corresponding financial needs will be considered. The Council's recommendations will then go to the Secretary of the United States Treasury and the Allied Governments concerned. The Council will indicate the priorities desired by the respective Governments, but final decision as to priorities between these and the demands of the United States for the latter's own purposes will be made at Washington.

When Treasurer McAdoo received announcement of the selection of Assistant Secretary Crosby as president of the Inter-Allied Council he said: "I am greatly pleased that such an honor as the selection of Mr. Crosby to the Presidency of the Inter-Allied Council should come to the United States and the Treasury Department. It is very gratifying also to know that the plans for the conference have been consummated. As a result of the organization of the Council, I am confident that we shall get more effective use of the credits which the United States is extending to the Allies. A very distinguished honor has been conferred upon Mr. Crosby. I know of no man who by reason of his ability, loyalty and general knowledge of the situation is more competent to discharge the duties of the Presidency of the Council."

Mr. Crosby, in addition to his wide experience electrically, financially and as a traveler, is a man of most charming personality, never permitting his severe or heavy duties to change a sunny temperament, combined with a sense of humor. He possesses that rare faculty of meeting, greeting and disposing of men in the most genial and tactful manner.

Mr. Crosby was born at Ponchatoula, La., April 21, 1861, and entered the United States Military Academy in 1878, graduating in 1882. He resigned from the army as first lieutenant of engineers in 1887, to accept the position of general superintendent of the Sprague Electric Railway & Motor Company. Later he was made general manager of the railway department of the General Electric Company, and from 1887 to 1896 was an experimenter in and author on electrical subjects. He then entered private business and was president of several local electric railway and lighting companies in Washington, D. C., and several public utility corporations in Wilmington, Del., Chester, Pa., and Trenton, N. J. He explored portions of Abyssinia and Soudan in 1900, and portions of Turkestan and Tibet in 1903. He traversed Mesopotamia and made explorations in Borneo in 1913-14. He served as director in charge of work of the Commission for Relief in Belgium for six months of 1915, in the portion of Belgium and of France now occupied by Germany. He became assistant secretary of the treasury April 17, 1917.

Oscar T. Crosby.

Mr. Crosby is a member of the Royal Geographical Society (London); president of the World's Federation League. He is a member of the Metropolitan and Cosmos Clubs (Washington); University Club (New York); Army & Navy Club (Washington); Montgomery Country Club (Washington). He is the author of Tibet and Turkestan; How to Strike—Why to Strike, 1910; Draft Constitution for International Court; Electrical Railway in Theory and Practice; and various papers on geographical and scientific subjects.

STERLING ELECTRIC COMPANY, Minneapolis, Minn., is displaying a service flag on which appear 17 stars, representing approximately 16 per cent of the company's employees in service.

T. J. MCGRATH, secretary to H. M. Byllesby, of H. M. Byllesby & Company, has entered the Navy as chief yeoman, and Eugene Stoddard, of the engineering department, has joined the ordnance department at Washington.

GENERAL FIRE EXTINGUISHER COMPANY in its January quarterly of the Grinnell Automatic Sprinkler Bulletin reports that it is proud of its men in the Army and now lists the names of 180 employees in the various branches of military service. The position each employee filled before leaving for service is also given. The company states that the employees at home are also doing their share to defeat efforts of the enemy agents by curbing fire menace, etc., thus conserving the resources of the country.

PROF. WILLIAM H. WALKER, head of the chemical engineering department of the Massachusetts Institute of Technology, has been commissioned lieutenant-colonel in the Chemical Corps, U. S. A., a newly created branch of the war department. He will have charge of co-ordinating the chemical activities in this country while Dr. Raymond F. Bacon, of Mellon Institute, Pittsburg, will be engaged in the same capacity in France.

HARRY G. SMITH, formerly assistant secretary of the National Electrical Contractors' Association, Utica, N. Y., who answered his country's call October 1, is getting ready to shake hands with the Kaiser and is advancing in military rank and file. Before joining forces with the National contractors Mr. Smith was employed by Crouse-Hinds Company, Syracuse, N. Y., in an engineering capacity. He has also worked in the engineering departments of such large concerns as the Straight-Line Engine Company, the Crucible Steel Company and the Franklin Automobile Company, with which he filled responsible positions. The National Electrical Contractors' Association has a number of men in service.

ROLL OF HONOR.

The electrical industry, perhaps to a greater extent than any other industry, has answered the call of the Nation for Men. As this is a war of engineers, naturally the technically trained men in the electrical industry have been in great demand and they have responded with splendid patriotism. Many of the large utility and industrial corporations have assigned men for Government service aside from those who have voluntarily entered or been called for service.

THE ELECTRICAL REVIEW *will welcome news concerning men who have entered the service or who are engaged in any patriotic duties.*

Personal

W. Rufus Abbott and L. A. Ferguson Board Members Chicago Association of Commerce—S. R. Inch Promoted

WAYNE WARFIELD has been appointed superintendent of lighting of the Savannah Electric Company, Savannah, Ga. He succeeds J. L. Alexander, who has held the position for the last four years and who resigned to accept a position with the El Paso Electric Company. Mr. Warfield, who is a native of Savannah, some years ago was an employee of the Savannah Electric Company.

W. RUFUS ABBOTT, general manager of the Chicago Telephone Company, has been elected a member of the board of directors of the Chicago Association of Commerce. Mr. Abbott, who has been connected with the Chicago Telephone Company since 1893, became general manager in 1914, succeeding H. F. Hill. He has filled successively and successfully the positions of order clerk, chief clerk to general superintendent, special agent in charge of rights of way and claims, superintendent of suburban division, and general commercial superintendent. He has held the offices of director, vice-president and president of the Chicago Athletic Club; director, vice-president and president of the Edgewater Country Club; secretary of the Industial Club; director and secretary of the First State Industrial Wage Loan Society; committeeman on the Sub. Div. No. 62 City Transportation and Public Utilities Membership and Executive Committees of the Chicago Association of Commerce; treasurer Delavan Lake Golf Club; commodore, Delavan Lake Yacht Club, and plain membership in Chicago Club, Electric Club-Jovian League, Chicago Motor Club, Aero Club of Illinois and Chicago Art Institute.

SYDNEY R. INCH, who was operating manager of the Utah Power & Light Company, Salt Lake City, has been promoted to vice-president and general manager of that company, effective February 1. He succeeds C. E. Grossbeck. Mr. Inch, who has been operating manager of the company practically since its organization, and whose activities have been largely confined to the western states, has done work in practically every field of public utility service. He has been placed in entire charge of the company's extensive properties in Idaho, Utah and western Colorado. The appointment of Mr. Inch as vice-president and general manager carries with it several other changes in the company's organization. M. H. Aylesworth, who has been a member of the Colorado Public Utilities Commission since 1913, has resigned that post to join the executive staff of the Utah Power & Light Company, as assistant to the vice-president and general manager. The work of the operating manager's office is to be divided between W. R. Putnam, sales manager and manager of the Salt Lake division of the company, and Markham Cheever, chief engineer of the company.

HARRY A. PORTER, president of Harry A. Porter, Inc., 40 South Clinton Street, Chicago, and vice-president of the Electric Club-Jovian League, has been elected chairman of the Electrical Subdivision of the Chicago Association of Commerce.

L. E. CALDWELL, manager of the Iowa City Light & Power Company, of Iowa City, Iowa, for the last five years, has resigned and accepted the position as manager of the La Crosse district of the Wisconsin-Minnesota Light & Power Company, which includes the gas, electric and heating plants in La Crosse, Wis. Mr. Caldwell also resigned as secretary and treasurer of the Iowa Section of the N. E. L. A., which position he has held for the last two years. He took charge at La Crosse January 15.

L. A. FERGUSON, vice-president of the Commonwealth Edison Company, 72 West Adams Street, Chicago, has been elected a member of the board of directors of the Chicago Association of Commerce. Mr. Ferguson needs no introduction to the electrical industry, being a recognized authority in the country on central station practice and has contributed many valuable papers to various associations, scientific societies and universities. He has been with the Commonwealth company for many years, and step by step has filled important and responsible positions. He was elected president of the Association of Edison Illuminating Companies for the year 1901-2 and re-elected to the same office for the year 1902-3. He was elected president of the National Electric Light Association for the year 1902-3 and in 1908 was elected president of the American Institute of Electrical Engineers. He is a member of the Commercial Club of Chicago, the University Club, the Union League, Chicago Athletic, Mid-Day, Evanston Country Club and the Onwentsia and Glenview golf clubs. He has always been interested in public-spirited work in Chicago.

OBITUARY.

WINFIELD SCOTT SIMS, Brooklyn, N. Y., well known as an inventor of various electrical devices, died January 7, at St. Michael's Hospital, New York, aged 74 years. He is survived by his widow, two daughters and one son.

ROBB MACKIE, assistant to manager of the supply department, Westinghouse Electric & Manufacturing Company, East Pittsburgh, died at his residence, 117 North Linden Avenue, Pittsburgh, January 5. Mr. Mackie had been in poor health for some time and about ten days before his death was confined to his residence with an attack of pneumonia, to which he finally succumbed.

Mr. Mackie was born in Georgetown, D. C., in 1857, attended school at the Newark (N. J.) Academy and his early schooling and training led him to choose the electrical profession for his life's work. His first work was at Hoosac Falls, Mass., where he worked as an electrician for L. D. Tibbetts. One of the early positions he filled was that of engineer's assistant in the work of erecting the Brooklyn Bridge under the supervision of Mr. Roebling. This was a wonderful experience and many were the interesting stories that the young engineer told of this famous undertaking. Subsequently he became connected with the Fort Wayne Electric Works at Fort Wayne, Ind., and later with the

Robb Mackie.

Manhattan Electric Supply Company, of New York. While at work for this company in the plant at Newark, N. J., Mr. Mackie attracted the attention of George Westinghouse, who was then negotiating for its purchase, by the earnest and thorough manner in which he performed his work. When the Manhattan Electric Supply Company was taken over by the Westinghouse Electric & Manufacturing Company, Mr. Mackie, then works engineer, was made the head of the correspondence and production department of the Newark plant. On November 1, 1904, he was transferred to the New York office of the Westinghouse company as chief correspondent, which position he filled until May 14, 1906, when he was transferred to the East Pittsburgh works as head of the detail and supply correspondence department. Subsequently he was appointed assistant to manager of the supply department, which position he occupied until the time of his death.

Mr. Mackie leaves a widow, Mrs. Mary Steere Mackie; one daughter, Mrs. Walter Taylor, a missionary in China, and one son, Lieut. Robb S. Mackie, U. S. Regular Army, stationed at Fort Crook, Nebraska. He was a member of Calvary Episcopal Church.

Current News

Weekly Record of Construction Activities—Conventions

EASTERN STATES.

GARDNER, MASS.—Central Oil & Gas Stove Company has commenced the construction of a one-story transformer and pump house, about 16x32 feet and 80x80 feet, respectively, at its local works.

WEST SPRINGFIELD, MASS.—Gilbert & Barker Company, Church street, has filed plans for the construction of the proposed one-story addition to its local power plant, about 57x93 feet. Contract has been awarded to the H. Wales Lines Company, 134 State street, Meriden, Conn., and work on the structure has been commenced.

HARTFORD, CONN.—Southern New England Telephone Company, 185 Pearl street, has awarded a contract for the construction of additions and alterations in its telephone exchange plant on Pearl street, to cost $10,000. J. H. Grozier, 721 Main street, Hartford, is the contractor.

BROOKLYN, N. Y.—Transit Development Company has filed plans for the erection of a large addition to its generating station at Kent and Division avenues. When completed, the structure will be about 275x303 feet, one and six-stories high. The new addition is estimated to cost $500,000. T. S. Williams is president of the company, which is a subsidiary of the Brooklyn Rapid Transit Company.

BUFFALO, N. Y.—City council is considering a bond issue for $60,000 for the installation of underground conduits for the police and fire alarm system to replace the present overhead wires.

BUFFALO, N. Y.—Definite steps in the direction of a municipally-owned or controlled electric plant have been taken by the Council, and a fund of $10,000 has been created to engage an engineer to draft plans and investigate locations for a plant to supply power to the city. The appropriation is to pay for the services and expenses of a competent electrical engineer to prepare plans and submit reports on the location, cost and character of plants and method and cost of transmission of electrical energy and distribution within the limits of Buffalo. The same is to be a guide for the city when determining the feasibility of a municipally-owned or controlled plant.

GOWANDA, N. Y.—Gowanda Light & Power Company has made application to the Public Service Commission for permission to construct and operate a local electric plant, and for approval of the franchise.

LONG ISLAND CITY, N. Y.—Fire, on January 7, destroyed a portion of the plant of the New York & Queens Electric Light & Power Company in Mills street, with loss estimated at $15,000. The damaged power house was a two-story brick structure, and it is said the destroyed section will be immediately rebuilt.

NEW YORK, N. Y.—Weyant Electrical Company has filed notice of an increase in its capital from $5,000 to $15,000 for expansion.

NEW YORK, N. Y.—Joseph Stern & Son, 618 West Fortieth street, have awarded a contract for the construction of a new power house addition to their plant to Edward D. Broderick, 110 West Fortieth street, New York.

NEW YORK, N. Y.—Hydraulic Electric Company has incorporated with a capital of $50,000. The incorporators are F. J. Hobbs, Randolph C. Shaw and A. W. Britton, New York City.

NEW YORK, N. Y.—Automatic Electric Light Company has incorporated with a capital of $1,000,000, to manufacture electric lamps, globes, etc. The incorporators are S. B. Howard and G. V. Reilly, 65 Cedar street, New York City.

SCHENECTADY, N. Y.—General Electric Company has filed notice with the Public Service Commission of an increase in its capital from $105,000,000 to $125,000,000 for extensions.

CAMDEN, N. J.—Warren Webster & Company, manufacturers of heating apparatus, have filed notice with the Board of Public Utility Commissioners of an increase in its capital from $150,000 to $450,000 to provide for expansion.

EAST ORANGE, N. J.—City Council has approved a requisition for an appropriation of $52,500 made in the annual budget for the year 1918, to be used for street lighting.

EDGEWATER, N. J.—Spencer Kellogg & Sons have awarded a contract for the construction of a one-story power house addition, about 50x50 feet, at its plant. The John W. Ferguson Company, 152 Market street, Paterson, is the contractor.

JERSEY CITY, N. J.—Erie Railroad Company, 50 Church street, New York, has filed plans for the construction of a power house at its local yards at the foot of Pavonia avenue. Contract has been awarded to F. A. Knapp, Jersey City

KEARNY, N. J.—Federal Shipbuilding Company, Hackensack River, has filed plans for the construction of a large power house and boiler shop at its plant to cost $60,000 and $170,000, respectively. The buildings will be of brick and steel construction.

NEWARK, N. J.—Beyer Engineering Company, Newark, submitted a low bid to the Board of Freeholders for the installation of electric light and power wiring in the laundry building at the County Hospital, Overbrook, at $14,174. Paul H. Jaehnig, Newark, submitted a bid at $14,990.

NEWARK, N. J.—Public Service Electric Company has made announcement, that due to the acute shortage of coal, it has been compelled to place all industrial plants in North and Central Jersey on a half-time schedule, effective January 9. Power will be supplied to plants in Passaic, Union, and Somerset Counties on Tuesdays, Thursdays and Fridays, and to Essex and Bergen Counties on Mondays, Wednesdays, and Saturdays. The company does not anticipate changing the power schedule for Mercer, Burlington, Camden, Gloucester and Monmouth Counties at this time.

NEWTON, N. J.—City has completed and inaugurated operations in a section of its electric street-lighting system. The Newton Light & Power Company is planning to complete the work as soon as the weather permits.

RED BANK, N. J.—Due to the shortage of coal, the Public Service Electric Company has been compelled to suspend service for the operation of the street-lighting system until further notice.

TOMS RIVER, N. J.—Toms River Electric Company has been granted permission by the Board of Public Utility Commissioners to issue stock to the amount of $15,000 for extensions, etc.

TRENTON, N. J.—Trenton & Mercer County Traction Corporation has commenced extensive improvements at its plant. Work has been started on the placing of foundations for the new 2000-horsepower engine and generator, and this is progressing rapidly. The company is also rebuilding the section of its car barns which was recently destroyed by fire.

BRIDGEPORT, PA.—Philadelphia & Reading Railway Company has awarded a contract for the construction of a one-story brick and concrete addition to its local power house, about 95x100 feet.

COATESVILLE, PA.—Chester Valley Electric Company has commenced the construction of power line from its new electric station at Phoenixville to Coatesville, a distance of about 18 miles, for the purpose of supplying current to the local plants of the Midvale and Lukens Steel Companies.

HARRISBURG, PA.—Harrisburg Light & Power Company is planning for extensive improvements in its steam heating plant. C. M. Kaltwasser is manager.

HARRISBURG, PA.—Allegheny County Steam Heating Company, Pittsburgh, has made application to the Public Service Commission for permission to lease a plant in the Allegheny County prison as an auxiliary to its plant.

HAZLETON, PA.—Harwood Electric Company's plant was damaged by fire recently; loss $25,000.

NEW BOSTON, PA.—The New Boston Coal Land Company is planning for the complete electrification of its plant at the Morea mine.

PHILADELPHIA, PA.—DeLong Hook & Eye Company, Broad and Wallace streets, is making rapid progress in the construction of its one-story power house at Twenty-first and Clearfield streets. The new structure, in connection with a large factory building also being erected, will cost $250,000.

PHILADELPHIA, PA.—Counties Gas & Electric Company has filed notice with the Public Service of a bond issue for $300,000 to provide for extensions, improvements, etc.

PHILADELPHIA, PA.—City Council has approved an appropriation of $60,000 for heat, light, and power purposes for 1918.

PHILADELPHIA, PA. — Philadelphia Electric Company is planning for the construction of a large power house at Beach and Palmer streets. When completed, the plant is estimated to cost $8,000,000.

PITTSBURGH, PA.—West Penn Power Company has filed with the Public Service Commission, applications for approval of franchises and contracts with the boroughs of Carmichaels, Bentleyville, North Irwin, Clarksville, Jefferson, and Rices Landing, covering the construction of electric lighting facilities and electric lighting contracts.

WILLIAMSPORT, PA.—The Lycoming Edison Electric Company is planning for extensive improvements in its plant to cost about $250,000.

LOCKHART, S. C.—Lockhart Power Company is having plans prepared for the construction of a large hydroelectric plant.

BALTIMORE, MD.—Bartlett Hayward Company, Scott and McHenry streets, has filed plans for the construction of a transformer station at Hamburg and Gunpowder streets. The structure will be of reinforced concrete and steel construction. Contract has been awarded to Morrow Brothers, Fidelity Building, Baltimore.

GLENLYN, VA.—Appalachian Power Company has completed final plans for the construction of its new steam-driven electric generating plant, which will include the erection of a power house, brick and concrete, about 150x150 feet, which, with equipment, will cost $2,000,000 and generate, for initial operations, 18,750 K. W. Contracts for construction have been awarded.

SUFFOLK, VA.—Virginia Railway & Power Company is arranging to issue notes for $950,000 to provide for extensive improvements, including the construction of an electric transmission system from Petersburg to Suffolk.

THE PLAINS, VA.—Plains Electric Light Company is planning for the reconstruction of its electric light and power plant recently destroyed by fire.

BRIDGEWATER, N. C.—Rapid progress is being made in the construction of the hydroelectric plant of the Western Power Company. The power house will

be equipped with machinery to include two turbines operating under a 140-foot head, and 26,400 horsepower will be developed. The Hardaway Contracting Company, Columbus, Ga., has the general contract.

AMERICUS, GA.—City is considering establishing a municipal lighting plant.

ATLANTA, GA.—Georgia Railway & Power Company will double track Camp Gordon line to a point near the intersection of Piedmont road and Peachtree road.

GAINESVILLE, FLA.—A contract has been awarded to A. J. Krebs & Son, Atlanta, Ga., to erect a telephone building for the Southern Bell Telephone & Telegraph Company.

JACKSONVILLE, FLA. — Jacksonville Traction Company will extend electric railway between Ortega and Camp Johnston.

MIAMI, FLA.—Miami Traction Company contemplates building a line between Miami and Miami Beach. J. R. Tatum and others are interested.

NORTH CENTRAL STATES.

CHADRON, OHIO.—Bonds of $25,000 have been voted for municipal lighting.

LUCKEY, OHIO.—Luckey Light & Power Company has incorporated with a capital of $5000. Chester C. Martin, George Welling, William Aspachen, William L. Hoelter and William H. Schwane are the incorporators.

HAMMOND, IND. — Indiana Public Service Commission has authorized the reorganization of the Gary Street Railway Company, which takes over the Gary interurban and the East Chicago Street railway, both in the hands of receivers. Issues of $2,500,000 and $800,000 debenture gold bonds are to be made.

INDIANAPOLIS, IND.—Standard Machine & Electric Company has increased its capital stock from $75,000 to $100,000. Frederick W. Marschke, president of the company is reported to have filed a petition to change the name of the firm to the Marschke Manufacturing Company.

JAMESTOWN, IND.—People's Co-operative Telephone Company has increased its capital from $5000 to $10,000. This line will be extended.

MARION, IND. — Delta-Star Electric Company has increased its capital stock from $90,000 to $115,000.

CANTON, ILL.—Canton Gas & Electric Company has removed into its newly remodeled room.

CHESTER, ILL.—The office and salesrooms of the Saline Electric Company have been destroyed by fire.

QUINCY, ILL.—Quincy Railway Company has installed a new 1000-horsepower heater in its power house.

MENOMINEE, Mich.—Menominee Electric Manufacturing Company is receiving bids for the erection of four one-story additions to its works to cost about $60,000.

MADISON, WIS.—Di-Electric Manufacturing Company has incorporated here with a capital of $40,000. Edwin W. Smythe, H. A. Smythe, Jr., and E. J. Frautschi are the incorporators. It is reported that the company has removed here from Chicago and will build a plant here.

RACINE, WIS.—Milwaukee Light, Heat & Traction Company has made many improvements in 1917 and recently added another large unit, making the total 60-cycle generating capacity 16,000 kilowatts. This new unit is a 10,000-kilowatt turbo-generator, which supplies current to the 2800-3980-volt, 60-cycle equipment for lighting and power purposes. This equipment was manufactured by the General Electric Company.

RIDGEWAY, WIS.—Mineral Point Public Service Company, of Dodgeville, has about completed the building of the new lighting system, running from Dodgeville to Ridgeway. In spite of cold weather, delayed shipments of material, etc., the work will be completed on time.

STOUGHTON, WIS.—Porter Electric Line Company has incorporated. The officers of the company are Joe Porter and G. F. Miller. The electric line to be installed will connect with the Stebbinsville-Stoughton conduit. It will be about 10½ miles long and will extend south from Dunkirk to the Cooksville-Edgerton road, and from there west to Cooksville. From Cooksville it will go south to Tolles Corner. Many farmers will use it for power and lighting purposes.

HIBBING, MINN.—Water and light commissioners are considering building a transmission line.

NASHWAUK, MINN.—The municipal electric light plant burned recently; loss $2000.

SEBEKA, MINN.—Council has asked the Little Falls Water Power Company to build an electric transmission line to Sebeka.

FALLS CITY, NEB.—Election was held January 15 for the purpose of voting on a bond issue of $60,000 for constructing electric light plant.

DATES AHEAD.

Electrical Contractors' Association of State of Missouri. Annual convention, January 19. Secretary, A. J. Burns, 318 West Tenth Street, Kansas City, Mo.

Minnesota Electrical Contractors' Association. Annual convention, Minneapolis, Minn., January 21. Secretary, G. M. Jones, 112 South Seventh Street, Minneapolis.

Northern White Cedar Association, Twenty-second annual meeting. Hotel Radisson, Minneapolis, Minn., January 22-23, 1918. Secretary, N. E. Boucher, 743 Lumber Exchange, Minneapolis.

Western Association of Electrical Inspectors. Annual meeting, Memphis, Tenn., January 29-30-31. Secretary, W. S. Boyd, 175 West Jackson Boulevard, Chicago, Ill.

Illinois Electrical Contractors' Association. Semi-annual convention, Chicago, February, 1918. Secretary-Treasurer, L. B. Van Nuys, 238 South Jefferson Avenue, Peoria, Ill.

Vermont Electrical Association. Annual meeting February, 1918. Secretary-Treasurer, C. H. West, Rutland, Vt.

National Association of Electrical Inspectors. Annual convention, New York, March, 1918. Secretary-Treasurer, William L. Smith, Concord, Mass.

Wisconsin Electrical Association. Annual meeting, March, 1918. Secretary, George Allison, 1419 First National Bank Building, Milwaukee, Wis.

National Association of Electrical Inspectors. Annual meeting, New York, March, 1918. Secretary-Treasurer, William L. Smith, Concord, Mass.

Tri-State Water & Light Association. Annual meeting, Charlotte, N. C., April, 1918. Secretary-Treasurer, W. F. Steiglitz, Columbia, S. C.

Southwestern Society of Engineers. Annual meeting, April, 1918. Secretary, C. E. Barglebaugh, 703 First National Bank Building, El Paso, Tex.

Kentucky Association of Electrical Contractors. Annual meeting, May, 1918, Louisville, Ky. Secretary, F. F. Valinoti.

Georgia Electrical Contractors' Association. Annual meeting, June, 1918. Tybee Island, Ga. Secretary, Dan Carey, Atlanta Builders' Exchange, Atlanta, Ga.

National Electrical Credit Association. Annual meeting, June 1, 1918. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

New York Electrical Credit Association. Annual meeting, June, 1918. Secretary, Franz Neilson, 120 Broadway, New York.

Society for the Promotion of Engineering Education. Annual meeting, Evanston, Ill., June, 1918. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

Texas State Association of Electrical Contractors. Annual meeting, Galveston, Tex., June 15, 1918. Secretary, H. S. Ashley, Fort Worth, Tex.

Oregon Association of Electrical Contractors & Dealers. Annual meeting, September, 1918. Secretary-Treasurer, J. W. Oberender, 302 Dekum Building, Portland, Ore.

Northwest Electric Light & Power Association; affiliated with N. E. L. A. Annual meeting September 11, 1918. Secretary, George L. Myers, Pacific Power & Light Company, Portland, Ore.

SOUTH CENTRAL STATES.

FAYETTEVILLE, TENN.—At a meeting of the stockholders the Fayetteville Electric Light & Power Company decided to spend $25,000 in water power on Elk River in order to conserve the coal supply of the county. The necessary machinery will be purchased at once.

PRESSMEN'S HOME, TENN.—Rapid progress is being made by the Clinchfield Hydro-Electric Company in the construction of its hydroelectric plant near the Clinch River. The company is planning to generate 1000 horsepower for initial operations. An eight-mile transmission system will also be constructed, the entire work to cost approximately $60,000.

ALEXANDER CITY, ALA.—An election will be held January 21 upon issuance of $10,000 of municipal bonds for enlarging electric light plant.

FOLEY, ALA.—City has voted $3000 in bonds for installing electric lighting system.

MOBILE, ALA.—Mobile Electric Company is planning for the early construction of a transmission line to the plant of the Chickasaw Shipbuilding Company, a distance of about five miles, to cost $8,000. A. S. Quackenbush is general superintendent.

ONEONTA, ALA. — Alabama Water Company has bought the Oneonta Utility Water & Light Company properties and will improve and operate same.

WIGGINS, MISS. — Municipal electric light and water works plants will be improved. Plans will be prepared by architect Xavier A. Kramer, of Magnolia, Miss.

BLANCHARD, OKLA.—Council is planning ways and means to secure electric lighting.

HOMINY, OKLA.—City is considering the construction of an electric-lighting system.

MIAMI, OKLA.—Bilharz Mining Company will build a central generating station to supply electricity to the miners.

SEMINOLE, OKLA.—City voted $5000 bonds to erect an electric lighting system.

WOODWARD, OKLA.—City has authorized a bond issue for $20,000 to provide for the construction of an electric light plant.

HOUSTON, TEX.—Houston & Texas Railway will build an interlocking signal tower, which is to be 24 feet high and to cost $16,000. Address I. A. Collingham, special engineer, Houston.

NACOGDOCHES, TEX.—City is considering the installation of additional equipment and machinery in electric light plant, to double output.

WESTERN STATES.

LIVINGSTON, MONT.—A new ornamental lighting system has been installed here and the work will be turned over to the city within a few days. A celebration is planned to be held at the time the switch will be turned to illuminate the city under the new system.

REDSTONE, MONT.—The lighting plant here will be rebuilt. It is proposed to erect a new building in front of which the fire hall would be placed and connect the two, using the heat from the plant to keep the fire apparatus in shape for instant use. Machinery has been ordered, which will be an improvement over the old machinery.

BLACKFOOT, IDAHO.—City authorities are considering the matter of installing a cluster lighting system at this place.

DAVENPORT, WASH.—A high tension line from the Long Lake plant of the Washington Water Power Company in the northwest corner of Lincoln county to the Milwaukee railway at a point about 12 miles south of Odessa is soon to be located. The line in Lincoln county will be 65 miles long and cost of construction will be about $100,000. Permanent survey is to be started late in the winter.

EDMONDS, WASH.—Washington Coast Utilities has been granted a franchise for

installing an electric lighting system at this place.

SEATTLE, WASH.—Ordinance has been introduced in the council calling for the adoption of a new plan for building an elevated electric street railway on Whartcom avenue and Spokane street and calling for submission to the voters of a bond issue of $350,000 to cover cost of construction.

SPOKANE, WASH.—The loan of $2,-800,000 on short-time notes provided for by the Washington Water Power Company, has been subscribed. About $640,-000 of this is to be used for constructing extensions in Coeur d'Alene, Idaho, and the balance to refund notes outstanding.

PORTLAND, ORE.—Northwestern Electric Company is erecting an auxiliary plant to be modern in every detail and appointment. The company's capacity for supplying electrical power will be increased 50 per cent. The additional plant will have a capacity of 10,000 kilowatts, the equivalent of 13,500 horsepower, and completed will cost $1,500,000. Wilber E. Coman, vice-president and general manager of the company, is reported to have stated that the demand for electrical power in Portland vicinity, due to shipbuilding activities and the requirements of other local industries, has made it necessary for the company to increase the capacity of its power service. Plans are not only for taking care of present demands, but also for providing for the needs of the future. Arrangements are being made so that the capacity of the plant may be increased to 30,000 kilowatts or 40,000 horsepower. Charles C. Moore & Company, of San Francisco, Cal., designers and erectors of steam electrical plants in the West, have the contract for designing and installing the plant. This work will all be done under the general supervision of B. C. Condit and L. T. Merwin, engineers for the company. All the equipment and machinery has been purchased.

LOS ANGELES, CAL.—United Power Company has acquired property in the San Gabriel Canyon, formerly held by the Electric Power Company, and is planning for the erection of a new power plant at Iron Fork.

PROPOSALS

BELL WIRE AND MOTOR GENERATORS.—Bureau of Yards and Docks, Navy Department, Washington, D. C., will receive bids for 400,000 feet plain bell wire, for delivery at Mare Island, Cal., schedule 1639 and 30 sets of motor generators, for delivery at various yards, schedule 1653.

NEW PUBLICATIONS

MINING LAMPS AND MOTORS.—The Department of the Interior, Bureau of Mines, Washington, D. C., is distributing a pamphlet compiled by Albert H. Fay, dealing with coal mine fatalities in the United States, which includes a list of permissible explosive lamps and motors, and bulbs, glasses, igniters, etc., approved for use with those listed. This list of tested safety lamps, which supersedes all previous lists, is as follows: Approval 201 covers a permissible miners' flame safety lamp manufactured by the Koehler Manufacturing Company, of Marlboro, Mass.; 202 covers a permissible miners' flame safety lamp manufactured by Ackroyd & Best (Ltd.), Pittsburgh, Pa. This is relighted electrically. Permissible portable electric mine lamps, listed by H. H. Clark and approved by the Bureau, are: Approval 10 covers a portable electric mine lamp manufactured by the Edison Storage Battery Company, Orange, N. J., for use with BM-10 bulbs manufactured by the National Lamp Works and the Edison Works, both of the General Electric Company, and 26-V bulbs made by the Independent Lamp & Wire Company, New York City. Approval 12 covers the Concordia portable electric (hand lamp) mine lamp, with bulbs manufactured by the Concordia Safety Lamp Company, Pittsburgh. Approvals 13 and 13-A cover portable electric mine lamps manufactured by the General Electric Company, to be used with flexible cord with ironclad exide battery made by the Electric Storage Battery Company, Philadelphia; bulbs approved are BM-13, made by the Edison Lamp Works. Approval 14 covers Wico portable electric mine lamp, manufactured by the Witherbee Igniter Company, Springfield, Mass.; bulbs approved are BM-14, made by Edison Lamp Works and National Lamp Works. Approval 15 covers Concordia portable electric mine lamp manufactured by the Concordia Safety Lamp Company, Pittsburgh; bulbs approved being BM-15, made by the National Lamp Works. Approval 16 covers the Pioneer portable electric mine lamp, manufactured by the Hirsch Electric Mine Lamp Company, Philadelphia, with battery plates made by the Electric Storage Battery Company, and bulbs BM-16, made by the Edison Lamp Works. Coal-cutting equipment which has been approved by the Bureau is Approval 100, covering a 250-volt direct-current explosion-proof coal-cutting equipment, and 100-A, covering a 500-volt direct-current explosion-proof coal-cutting equipment, both manufactured by the Sullivan Machinery Company, Claremont, N. H. Approval 101, covers a 210-volt direct current explosion-proof coal-cutting equipment, and 101-A covers a 500-volt direct-current explosion-proof coal-cutting equipment, both manufactured by the Goodman Manufacturing Company, Chicago.

SOME ELECTRICAL PROPERTIES OF SILVER SULPHIDE is the title of Scientific Paper No. 310, prepared by George W. Vinal, associate physicist of the Bureau of Standards. An advance report of this appeared in the September 22 issue of the ELECTRICAL REVIEW. In commenting upon these properties Mr. Vinal states: "Silver sulphide may be prepared in the form of short wires or thin strips like a metal. The wire, which must be drawn hot, has been found to conduct electricity like a metal of high specific resistance and has a practically zero temperature co-efficient. The strip of sulphide, rolled at room temperatures, has a large negative temperature co-efficient and shows both metallic and electrolytic conduction at the same time. It has a volt-ampere curve characteristic of a pyroelectric conductor. The resistance of these strips has been examined with both alternating and direct current with the result that the alternating-current resistance was nearly always found to be higher than that with the direct current, and the passage of a small alternating current of a frequency as low as 60 cycles increased temporarily the resistance of the sulphide while a small direct current produced the opposite effect." Copies of this pamphlet may be obtained from the Government Printing Office, Washington, D. C., upon remitting five cents.

ELECTRIC PUMPING.—Bulletin No. 46, issued by Engineering Experiment Station, of Iowa State College, Ames, Iowa, is devoted to the subject of Electric Pumping, in which results of tests and operating records are given. This is an official publication, issued weekly, and the number referred to is a pamphlet of 80 pages. The treatise on electric pumping is a compilation of data, with observations and conclusions, based upon investigations of pumping operations, in the state of Iowa, which began in 1912. In municipal pumping, the deep-well and surface pumps are considered. In deep-well pumping, especially where the water stands at great depth below the surface, the air-lift pump is considered the most satisfactory, compressed air for which may be derived from a motor-driven compressor. Water containing gritty substances and injurious chemical elements will give the least trouble to the air-lift pump. In the use of reciprocating pumps, gritty sand in the water will wear the valves and cylinders: and in the use of centrifugal pumps impure water may have a rapidly wearing effect on the valves. However, reciprocating and centrifugal pumps are made for and used in deep-well survice. It is observed that where reliable electric current is available the motor-driven pump for low lift is gradually replacing those of other kinds of power. Data are given showing results of tests with centrifugal, reciprocating, propeller and air-lift pumps operating in deep wells, and results of tests with triplex plunger, centrifugal and piston pumps for surface pumping. Some useful comparisons are given of electric with other kinds of pumps, as to first costs, capacities and costs of operation. Results of tests with numerous types of electrically operated pumps are well presented in tabular form. This bulletin is illustrated by numerous cuts of electric pumping plants, in which are shown installations of several types of motor-operated pumps, both for deep-well service and low-head operations. One of the ilustrations is that of a differential deep-well reciprocating pump, motor operated through gearing. The data given constitutes a useful record of pumping operations in Iowa, and the conclusions are most favorable to the efficiency and economy of electric pumping.

THE SIZE AND SHAPE OF THE ELECTRON.—The January 4 journal of the Washington Academy of Sciences deals chiefly with a paper entitled "The Size and Shape of the Electron," by Arthur H. Compton, of the Westinghouse Lamp Company's Research Laboratory. A number of charts, formula and tables, are included to clarify descriptions.

INCORPORATIONS

BUFFALO, N. Y.—Century Telephone Construction Company. Capital, $10,000. To manufacture telephones and parts. Incorporators: W. M. Wilkens, E. H. Letchworth, and C. M. Baldy, Buffalo.

GREENVILLE, S. C.—Huntington & Guerry. Capital, $50,000. To engage in a general electrical engineering business. Incorporators: R. S. Huntington and Dupont Guerry, Greenville.

MEMPHIS, TENN. — Lalley Electric Farm Light Company. Capital, $10,000. To manufacture electrical supplies. Incorporators: G. T. and L. M. Taylor, and J. A. Goodman.

OKMULGEE, OKLA.—People's Electric & Gas Company. Capital, $75,000. To operate a local plant. Incorporators: G. E. Ortman, A. B. De Fresse, and H. Read.

JERSEY CITY, N. J.—Commercial Acetylene Supply Company has incorporated with a capital of $500,000. The incorporators are Cornelius A. Cole, Arthur R. Oakley, Paul E. Britsch.

MEDFORD, OKLA.—Medford & Northwestern Telephone Company. Capital, $1000. Incorporators: O. V. Williams, E. G. Costner and J. F. O'Conner.

MEMPHIS, TENN. — Lalley Electric Farm Light Company. Capital, $10,000. Incorporators: G. T. Taylor, L. M. Taylor, J. A. Goodman and others.

HILLSVIEW, S. D.—Hillsview Telephone Company. Capital, $2000. Incorporators: Fred Schneider and others.

PIERRE, S. D.—Cottonwood Valley Telephone Company. Capital, $25,000. Incorporators: Charles Shannon, M. B. Hinsvark and William Keel.

LOUISVILLE, KY.—Cheatham Electric Switching Device Company. Capital, $60,000.

CLEVELAND, OHIO.—Osborne Storage Battery Company. Capital, $10,000 Incorporators: Carroll K. Osborne, Earl H. Jaynes, C. D. Mason, M. L. Hoffman and A. D. Carlton.

JERSEY CITY, N. J.—The Standard Electric Manufacturing Company. Capital, $200,000. The company will manufacture electrical appliances of all kinds. The incorporators are Jules E. Brand, H. A. Black and Walter J. Hilton.

TOLEDO, OHIO.—Breco Electric Company. Capital, $50,000. The company will manufacture electric machines for charging storage batteries, and offices are located at 206 Huron street. The incorporators are M. G. Lang, H. A. Stafford.

NEW YORK, N. Y.—Pyrinol Flashlight Company. Capital, $25,000. Incorporators: F. Dameric, S. Goodman and N. F. Lefkaditis, 140 Liberty street, New York City.

HAROLD, S. D.—Harold Light & Power Company. Capital, $12,000. Incorporators: P. J. Suhn, Harry Weeney and David Miller.

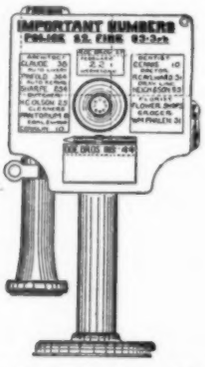
STEUBENVILLE, OHIO. — Windsor Electric Company. Capital, $10,000. Incorporators: H. M. Daughtery, R. L. Buffington, F. T. Wagenhals, E. S. Brown and R. F. Rarey.

Recent Patents

Selected and Summarized by Albert Scheible, Patent Attorney, 79 West Monroe Street, Chicago, Illinois

Protecting Oil Tanks from Lightning (1,251,037).—To protect oil tanks and similar metal structures from lightning, Francis B. Jackson, of Tulsa, Okla., provides a cage of wires radiating from a point above the top of the tank and running down obliquely to grounding stakes. These wires are cross-connected to each other, but all insulated from the metal of the tank.

Telephone Attachment (1,251,098.)—Petty attachments for displaying selected telephone numbers or the like at the transmitter of a phone seem in-

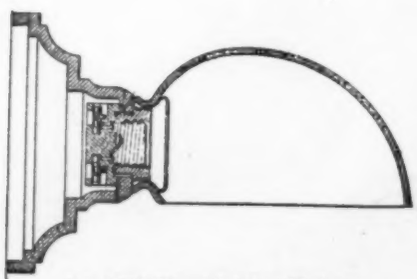


No. 1,251,098.—Telephone Attachment.

significant when compared with this miniature billboard devised by Maurice C. Pierce, of Madison, Wis. It provides advertising space, a calendar, a scratch pad and even a holder for a pencil.

Thermoelectric Fire Alarm (1,251,366).—The upper end of a thermometer tube opens into two chambers in which the wire terminals are located, and these terminals are so shaped that any mercury adhering to them is scraped off while adjusting them. Patented by Abilio M. S. Graves, Cambridge, Mass.

Lighting Fixture (1,251,406).—Assigned to the St. Louis Brass Mfg. Co., this patent to Anton Mooray shows a stemless bracket fixture in which the shade is clamped between the canopy portion and a part of the socket.



No. 1,251,406.—Lighting Fixture.

A series of brief comments on some of the recently issued electrical patents which appear to be of particular interest to our readers, the number after each heading being that of the United States patent to which the summary relates. Any correspondence regarding such patent matters should be sent direct to Mr. Scheible at the above address.

Electric Riveter (1,251,266).—This is a substitute for pneumatic riveters, invented by Wensel Morava, of the Morava Construction Co., bridge constructors, Peoples Gas Building, Chicago. The rivet-driving plunger is permanently connected to a drive wheel which is connected through a magnetic clutch to an electric motor, and electrical means are used for braking the wheel.

Synchronizing "Talking Pictures" (1,251,287).—Applied for nearly five years ago, this patent shows an arrangement for synchronizing a phonograph and a motion-picture projector, using a film-controlled switch and magnetic clutches as parts of the mechanism. The patent was assigned by Harrison W. Rogers to the R. & E. Singing Picture Co., of Wheeling, W. Va.

Recovering Metals Electrolytically (1,251,302).—Coming from Transvaal, South Africa, this invention shows the high development of applied ingenuity in that section. It discloses a process for precipitating metals from their solutions, patented by Urlyn C. Tainton, of Johannesburg. The solution is introduced into an electrolytic cell, and the cathode is rotated so rapidly in the solution that the metal precipitated on it is detached by this movement.

Fuse Device (Reissue Patent 14,416).—The fuse is held in a channel wider than itself, and means are provided for crushing and flattening the fuse when it begins to soften. The patent is issued to Edmund O. Schweitzer, of Schweitzer & Conrad, Chicago, and Alfred Herz, Edison Building, Chicago.

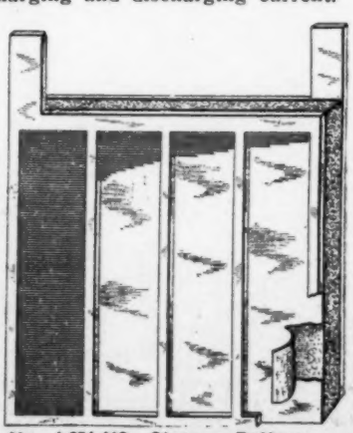
Lamp-Shade Holder (1,251,051).—Instead of clamping the shade-holder to the shell of a socket, William Knapp, of Bayonne, N. J., provides it with a number of fingers which extend up alongside the shell and are bent inwardly to hook over the crown of the socket. These fingers jointly support a thimble projecting from within the neck of the shade. The patent is assigned to the New York Electric Lamp Co.

Magnetic Clock Mechanism (1,251,171.)—An ingenious driving pawl arrangement for secondary or master-controlled clocks is shown in this patent to Lawrence O. Beard, of Lancaster, Pa.

Immersion Heater (1,251,411).—To avoid a waste of current when the heater is not in use, James O'Connor, of New York City, equips it with a switch which normally opens the circuit. When the heater is inserted in a cup of water or the like, its own weight presses on a finger underhanging the casing of the heater, and this closes the circuit.

No. 1,251,411.—Immersion Heater.

Making Secondary Batteries (1,251,412).—A patent to Charles S. Palmer, of Newtonville, Mass., on a lead storage battery and on process of making same. The lead supporting plates have quite thin and closely spaced laminations forming horizontal shelves between which the active material is placed. Thus prepared, the plates are immersed in a concentrated solution of acidified sodium bisulfate having a specific gravity of over 1.1, so as to moisten the active material with this solution, after which this material is subjected to alternate charging and discharging current.



No. 1,251,412.—Storage Battery.

Financial News

War Economies to Be Effected in Bond Distributing.

The bond department of the Equitable Trust Company of New York City has announced the details of a plan for economical co-operation among independent bond dealers and banks with bond departments throughout the country. The plan provides for the elimination of a great deal of the local machinery now necessary in the distribution of securities. It will furnish service to local dealers and banks through a central organization. Many dealers and banks throughcut the country have already become participants in the plan, as it meets the necessity for "Shortening Sail" due to war conditions and the lack of trained bond men.

One prominent dealer said of this plan: "I now feel that the curtailment of my organization, due to the army draft and stringent conditions in the bond business, will not affect the service I can render my clients. In fact I feel that my service has been vastly improved, and I am better able to meet the competition of the large international bond houses maintaining local offices." The rapidity with which this plan is being adopted by dealers and banks augurs well for its success as an economical war measure in the security business.

Toledo Traction, Light & Power Company Notes.

An announcement of interest to the Doherty organization was made yesterday by Harris, Forbes & Company and the National City Company of New York in offering $10,500,000 two-year 7 per cent bonds of the Toledo Traction, Light & Power Company, at 98½ and interest, to yield 7.82 per cent. The bonds will be secured by a first collateral lien on practically the entire electric light and power and street railway business of Toledo. They will also be secured by a lien, subject to divisional bonds, on the artificial gas and heating plants, and the interurban lines aggregating 121 miles of track. The income of the company applicable to the payment of the interest on the new bonds is about twice the amount required. The proceeds of the new issue will be employed for the retirement of the $8,699,000 bonds of the Toledo Traction, Light & Power Company maturing February 1, and to cover in part the construction costs of the extensions and additions made and being made to the system by the Acme Power Company.

Westinghouse Notes.

The Westinghouse Electric & Manufacturing Company has sold $15,000,000 one year 6 per cent notes to a syndicate headed by Kuhn, Loeb & Company. The notes will be dated February 1, 1918, and mature on February 1, 1919. Both principal and interest will be payable without deduction for any tax or taxes. The notes were offered at 99 during the week.

Gold Bonds of Rockford & Interurban.

Rockford & Interurban Railroad Company has received authority from the Illinois Public Utilities Commission to issue 5 per cent gold bonds to the amount of $150,000.

Copper Production in 1917.

Copper valued at more than half a billion dollars was produced in the United States in 1917. Production was slightly less than in 1916, the geological survey announced recently in statistics for the year. Production from domestic ores amounted to 1,890,000,000 pounds, or 38,000,000 pounds less than 1916; output from primary sources, domestic and foreign, was 2,362,000,000 pounds, an increase of 103,000,000 pounds over 1916. Domestic production was valued at $510,000,000, an increase of $35,000,000 over 1916. Stocks of refined copper at the beginning of 1917 were about 128,000,000 pounds, making the year's available supply, exclusive of secondary copper, about 2,490,000,000 pounds. Export for the first ten months were 953,876,000 pounds, and for the year were beyond the billion pound mark, although no figures are yet available. The supply for domestic consumption in 1917, assuming no change in stocks, was materially less than the 1,430,000,000 pounds available in 1916, the report states.

Cost of Producing Copper.

Estimates made of the cost of producing copper during 1917 place it as close to 15 cents per pound. This figure is the result of averaging the costs reported by the 40 American dividend-paying companies which operate strictly copper-producing mines. Those companies produced 1,788,000,000 pounds of metallic copper within the year. This output, when added to that of the non-dividend-paying companies, and of companies producing copper associated with other metals, shows a 1917 copper production of about 2,300,000,000 pounds by American mines.

Copper Prices.

There were rumors this week that the price of copper may be raised by the government from 23½ cents to 25 cents a pound. The basis for this is the claim of the small producers that they cannot afford to sell at the price of 23½ cents, which the government is willing to pay for the next four months. The larger producers are satisfied with the government price, but admit that production might be expanded at 25 cents. The whole question is whether an enlarged production is needed. It is said in the trade that 80 per cent of the United States production is going into war work.

Public Utility Dividends.

First National Copper Company has declared a dividend of 15 cents a share, payable February 25 to stock of record February 5. The distribution covers a six months' period, as last August there was paid to stockholders 40 cents a share. Prior to that, a dividend of 25 cents had been paid in December, 1916. Labor troubles forced cessation of operations by the Balaklala company for a period of two months last year, during the period covered by the current dividend, but resumption at capacity has since occurred.

Miami Copper Company has declared a quarterly dividend of $1.50 a share, payable February 15 to stock of record February 1.

Milwaukee Electric Railway & Light Company declared regular quarterly dividend of 1½ per cent on the preferred stock, payable January 31 to stock of record January 21.

Sierra Pacific Electric Company has declared a quarterly dividend of $1.50 a share on the preferred stock, payable February 1 to stock of record January 10.

Electrical Utilities Corporation declared regular quarterly dividend of 1¼ per cent on the preferred stock, payable January 15 to stock of record January 5.

United States Rubber Company declared the regular quarterly dividend of 2 per cent on the first preferred stock, payable January 31 to stock of record January 15.

Edison Electric Illuminating Company declared usual quarterly dividend of $3 a share, payable February 1 to stock of record January 15.

Reports of Earnings.

GENERAL ELECTRIC.

In connection with its application to list $2,030,300 additional capital stock, the General Electric Company has filed with the New York Stock Exchange the following condensed profit and loss account for the six months ended June 30, 1917:

Sales billed	$99,596,769
Cost of sales	82,220,915
Net	$17,375,854
Interest and discount, royalties, etc.	2,686,442
Total	$20,062,296
Interest on debentures and notes	285,822
Balance	*$19,776,474
Dividends—January to June 30, 1917	5,075,411
Surplus	$14,701,063
Surplus—December 31, 1916	34,160,753
Profit and loss surplus	$48,861,816

*Equal to $19.48 a share earned on $101,512,500 capital stock outstanding.

WEST KOOTENAY POWER & LIGHT COMPANY, LTD., ROSSLAND, B. C.

REPORTS FOR YEAR ENDING AUGUST 31, 1917.

Net profits for the year ending August 31, 1917, amounted to $30,930, this after writing off $99,736 for plant depreciation. Also providing for dividend on preferred shares and dividend on common stock, $182,666. During the year the operations of different plants have been continuous. For the year ending August 31, 1916, the revenue producing load was 11,152.1 horsepower. For the year ending August 31, 1917, the revenue producing load was 22,511.5 horsepower, thus showing an increase in power consumption over previous year of 11,359.4 horsepower.

ARKANSAS VALLEY RAILWAY, LIGHT & POWER COMPANY.

Earnings statement of the Arkansas Valley Railway, Light & Power Company for the twelve months ended November, 1916 and 1917, are reported as follows:

	1916.	1917.
Gross earnings	$1,252,209	$1,410,176
Expenses and taxes	691,004	770,095
Net earnings	561,204	640,080
Interest charges	343,546	368,344
Balance	217,658	271,735
Preferred dividends	50,347	64,645
Balance available for depreciation, amortization of discount, common dividends, etc.	167,311	207,090

SUBSIDIARY COMPANIES OF EASTERN POWER & LIGHT CORPORATION.

Statement of estimated gross revenues for the month of December, 1917 and 1916, and comparison:

	1917.	1916.	Increase, per cent.
Reading System.	$282,571.67	$242,452.62	16.5
Penn. Util. Sys.	130,000.00	96,171.87	35.2
West Va. Sys.	99,156.26	95,310.25	4.3
Claremont Sys.	29,521.00	27,042.46	9.1
Totals	$541,247.93	$460,977.20	17.4
Vincennes Sys.		13,045.65	. . .

SUBSIDIARY COMPANIES OF GENERAL GAS & ELECTRIC COMPANY.

Statement of estimated gross revenue for the month of December, 1917 and 1916, and comparisons:

	1917.	1916.	Increase, per cent.
Rutland System.	$ 43,295.11	$ 38,239.57	12.9
Northwestern Ohio System	25,000.00	24,436.32	2.3
Sandusky System	59,511.81	44,818.49	32.8
Binghamton Sys.	34,619.86	30,573.52	13.2
Sayre System	16,190.00	10,032.77	61.4
New Jersey Sys.	20,168.52	18,295.89	10.2
Interurban Gas System	850.00	816.77	4.0
Totals	$199,545.39	$167,213.33	19.3

FORT WORTH POWER & LIGHT COMPANY.

(Southwestern Power & Light Subsidiary)

	1917	1916
November gross	$ 96,345	$ 72,298
Net after taxes	44,534	45,097
Surplus after charges.	33,691	35,208
Twelve months' gross.	980,763	841,238
Net after taxes	543,660	494,442
Surplus after charges.	422,222	377,721
Balance after preferred dividends	345,222	377,721

BELL TELEPHONE SYSTEM.

American Telephone and Telegraph Company and Associated Companies, Not Including Connected Independent or Sub-Licensee Companies.

Earnings for 11 months ending November 30, 1917:

	1916.	1917.
Exchange revenues.	$172,103,650	$189,854,264
Toll revenues.....	66,207,555	77,284,106
Miscellaneous revenues	2,525,651	2,716,649
Total operating revenues	$240,836,856	$269,855,019
Depreciation	44,936,265	48,865,676
Current maintenance	31,563,908	37,473,608
Traffic expenses ..	48,723,572	61,570,146
Commercial expenses	23,421,509	25,993,407
General and miscellaneous expenses	10,552,834	12,690,143
Total operating expenses	$159,198,088	$186,592,980
Net operating revenues	81,638,768	83,262,039
Uncollectible revenues	1,394,727	1,193,706
Taxes	13,559,465	18,166,952
Operating income..	66,684,576	63,901,381
Net non-operating revenues	6,381,335	7,128,299
Total gross income	$ 73,065,911	$ 71,029,680
Rent and miscellaneous deductions	3,476,489	3,648,542
Interest deductions	16,473,742	20,113,181
Total deductions.	$ 19,950,231	$ 23,761,723
Balance net income	53,115,680	47,267,957
Deduct dividends (paid for nine months and estimated for two months)	32,167,945	33,562,276
Surplus earnings.	$ 20,947,735	*$13,705,681

*The figures for the eleven months of 1917 are partly estimated and are subject to some adjustments in December.

	Total Nov. 30, 1916.	Total Nov. 30, 1917.
Miles of wire (owned).	19,637,485	22,195,963
Bell stations (owned).	6,480,832	7,001,262
Bell connected stations	3,301,971	3,436,991
Total stations	9,782,803	10,438,253

ELECTRIC BOND & SHARE COMPANY.

Earnings of subsidiaries of Electric Bond & Share Company for November compare as follows:

TEXAS POWER & LIGHT.

(Southwestern Pr. & Lt. Subsidiary.)

	1917.	1916.
November gross.....	$ 274,952	$ 220,848
Net after taxes.....	108,324	109,422
Surplus after charges.	55,952	69,657
Twelve months' gross	2,553,558	2,220,860
Net after taxes.....	1,018,361	993,147
Surplus after charges	480,832	568,656
Balance after preferred dividends	235,832	381,989

ASHEVILLE POWER & LIGHT COMPANY.

	1917	1916
November gross	$ 40,244	$ 39,221
Net after taxes	15,247	13,938
Surplus after charges.	10,522	9,614
Twelve months' gross.	479,545	453,275
Net after taxes	217,310	184,942
Surplus after charges.	162,103	134,687

YADKIN RIVER POWER COMPANY.

	1917	1916
November gross	$ 45,408	$ 41,672
Net after taxes	31,471	32,762
Surplus after charges.	17,160	17,296
Twelve months' gross.	476,674	417,793
Net after taxes	340,925	306,677
Surplus after charges.	174,858	119,790

CHICAGO & NORTHWESTERN RAILWAY.

	1917	1916
November gross	$ 9,503,848	$ 8,802,477
Net after taxes	2,074,453	2,703,189
Net operating income	2,172,534	2,633,765
Eleven months' gross	99,476,024	89,644,378
Net after taxes	22,122,816	25,484,905
Net operating income	21,880,704	25,176,028

CAROLINA POWER & LIGHT COMPANY.

	1917	1916
November gross .....$	86,077	$ 72,694
Net after taxes	26,131	20,723
Total income	26,131	20,723
Surplus after charges.	12,886	6,597
Twelve months' gross.	907,505	775,370
Net after taxes	327,380	279,879
Total income	456,198	356,429
Surplus after charges.	286,301	187,810

BRAZILIAN TRACTION, LIGHT & POWER COMPANY, LTD.

Combined earnings, in milreis, of all subsidiaries, compare as follows:

	1917	1916
November gross ....$	7,695,000	$ 7,160,000
Net earnings	3,492,000	3,762,000
Eleven months' gross	84,131,000	77,573,000
Net earnings	43,376,000	42,655,000

HAVANA ELECTRIC RAILWAY, LIGHT & POWER COMPANY.

	1917	1916
November gross ....$	643,403	$ 517,627
Net earnings	358,911	323,526
Total net income ...	368,872	340,202
Surplus after charges	260,732	206,385
Eleven months' gross	6,315,811	5,457,438
Net earnings	3,564,165	3,373,506
Total net income	3,692,485	3,501,126
Surplus after charges	2,345,419	2,080,108

AMERICAN POWER & LIGHT COMPANY.

Earnings of all subsidiaries of Southwestern Power & Light Company, an American Power & Light Company subsidiary, compare as follows:

	1917	1916
November gross ....$	453,824	$ 402,564
Net earnings	191,342	206,185
Twelve months' gross	4,627,818	4,151,294
Net earnings	2,069,425	2,006,864

NEWPORT NEWS & HAMPTON RAILWAY GAS & ELECTRIC COMPANY.

	1917	1916
October gross .....$	142,310	$ 87,252
Net after taxes	48,853	33,045
Surplus after charges	25,972	13,856

UTAH POWER & LIGHT COMPANY.

(Including The Western Colorado Power Company)

	1917	1916
November gross .....$	482,004	$ 403,197
Net after taxes	246,081	217,810
Total income	246,081	217,810
Surplus after charges.	96,382	115,097
Twelve months' gross.	5,108,601	4,247,302
Net after taxes	2,640,293	2,194,163
Total income	2,670,293	2,194,163
Surplus after charges.	1,278,939	1,025,959

NORTHERN SECURITIES COMPANY.

Northern Securities Company reports as follows for year ended Dec. 31, 1917:

	1917	1916	1915	1914
Total income* .....$	271,045	$ 285,480	$ 119,704	$ 119,704
Expense, tax, etc.	24,483	18,161	20,474	21,848
Surplus .....$	246,562	$ 267,319	$ 99,230	$ 97,856
Divs. pd.....	138,383	79,074	79,074	79,072
Balance	$108,179	$ 188,245	$ 20,156	$ 18,784
Previous surplus	$2,879,103	2,690,859	2,670,703	2,651,919
P. & L. surplus.....$	2,987,282	$ 2,879,104	$ 2,690,859	$ 2,670,703

*Comprises dividends received through ownership of stock of Chicago, Burlington & Quincy Railroad Co. and interest received on loans and bank balances.

WEEKLY COMPARISONS OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

	Div. rate. Per cent.	Bid. Jan. 9.	Bid. Jan. 15.
Public Utilities—			
Adirondack Electric Power of Glens Falls, common	..	10	10
Adirondack Electric Power of Glens Falls, preferred	6	65	65
American Gas & Electric of New York, common	10 +extra	87	87
American Gas & Electric of New York, preferred	6	38½	38
American Light & Traction of New York, common	..	220	221
American Light & Traction of New York, preferred	6	90	92
American Power & Light of New York, common	4	40	41
American Power & Light of New York, preferred	6	71	71
American Public Utilities of Grand Rapids, common	..	24	21
American Public Utilities of Grand Rapids, preferred	6	54	54
American Telephone & Telegraph of New York	..	..	103
American Water Works & Elec. of New York, common	..	4¾	4½
American Water Works & Elec. of New York, particip	7	8	8
American Water Works & Elec. of New York, first preferred	..	59	59
Appalachian Power of Bluefield, common	..	2½	2¾
Appalachian Power of Bluefield, preferred	7	20	20½
Cities Service of New York, common	+extra	212	210
Cities Service of New York, preferred	6	70	74
Commonwealth Edison of Chicago	8	103	103
Comm. Power, Railway & Light of Jackson, common	4	31	31
Comm. Power, Railway & Light of Jackson, preferred	6	63	63
Federal Light & Traction of New York, common	..	3	3
Federal Light & Traction of New York, preferred	..	25	25
Illinois Northern Utilities of Dixon	6	75	76
Middle West Utilities of Chicago, common	2+extra	26	20
Middle West Utilities of Chicago, preferred	6	56	57
Northern States Power of Chicago, common	ex.div.7	60	61
Northern States Power of Chicago, preferred	ex.div.7	85	85
Pacific Gas & Electric of San Francisco, common	5	27	30
Pacific Gas & Electric of San Francisco, preferred	6	79	79
Public Service of Northern Illinois, Chicago, common	7	74	72¼
Public Service of Northern Illinois, Chicago, preferred	6	85	87
Republic Railway & Light of Youngstown, common	4	21	20¼
Republic Railway & Light of Youngstown, preferred	6	63	52
Standard Gas & Electric of Chicago, common	..	5½	5½
Standard Gas & Electric of Chicago, preferred	6	20	21
Tennessee Railway, Light & Power of Chattanooga, common	..	2	2
Tennessee Railway, Light & Power of Chattanooga, preferred	6	10½	10½
United Light & Railways of Grand Rapids, common	4	26	26
United Light & Railways of Grand Rapids, preferred	6	60	61
Western Power of San Francisco, common	..	80	80
Western Power of San Francisco, preferred	6	40	40
Western Union Telegraph of New York	extra	88	89
Industrials—			
Electric Storage of Philadelphia, common	4	49½	49
General Electric of Schenectady	8	133	129
National Carbon of Cleveland, common	8	56	56⅛
National Carbon of Cleveland, preferred	..	130½	130¾
Westinghouse Electric & Mfg. of Pittsburgh, common	+extra	40¾	39½
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	58	55

*Last sale.